AD-A131 343 AMMUNITION RESUPPLY MODEL VOLUME 1 METHODOLOGY AND USER'S MANUAL(U) COMBINED ARMS OPERATIONS RESEARCH ACTIVITY FORT LEAVENWORTH KS A RESNICK ET AL. MAY 83 1/2

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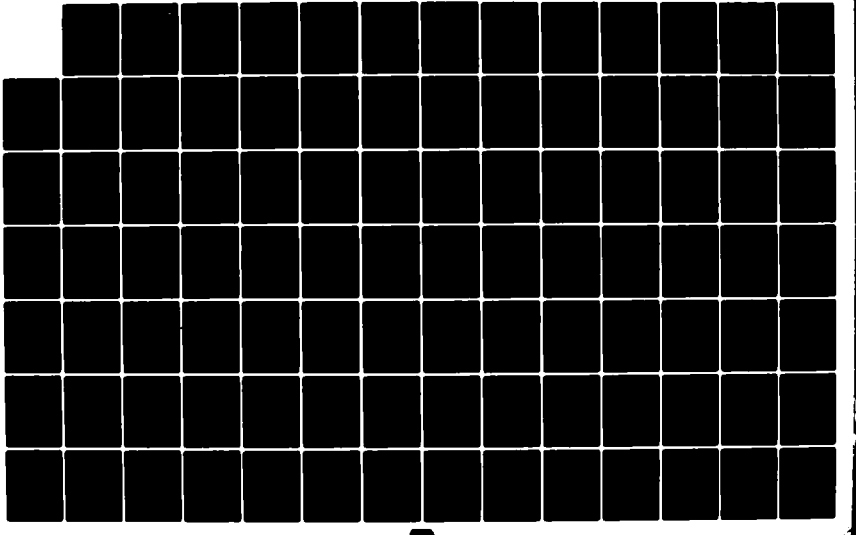

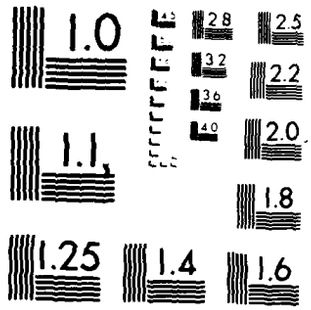

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AMMUNITION RESUPPLY MODEL METHODOLOGY AND USER'S MANUAL VOLUME I

TECHNICAL REPORT 6/83

UNITED STATES ARMY COMBINED ARMS CENTER

DIRECTORATE OF STUDIES AND ANALYSIS
COMBINED ARMS OPERATIONS RESEARCH ACTIVITY
FORT LEAVENWORTH, KS 66027

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Technical Report TR 6-83
May 1983

Directorate of Studies and Analysis
US Army Combined Arms Operations Research Activity
Fort Leavenworth, Kansas 66027

AMMUNITION RESUPPLY MODEL

VOLUME I

METHODOLOGY AND USERS MANUAL

by

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Report 6-83	2. GOVT ACCESSION NO. AD-A131343	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Ammunition Resupply Model - Volume I Methodology and Users Manual		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER TR 6-83
7. AUTHOR(s) MAJ Allan Resnick Mr. Clyde Harris Ms. Ann Hills		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE May 1983
		13. NUMBER OF PAGES 90
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for Public Release
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
War Game
Ammunition Resupply
Ammunition Consumption Rates

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report is one of three produced to document the Ammunition Resupply Model (ARM). The model was designed to simulate those activities associated with ammunition resupply - demand, reload and replenishment of stockage. Volume I is a programmers manual which contains FORTRAN code for all of the subroutines. Volume II contains a Standard Heavy European Data Base.

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Errata Sheet

P. 69 of Volume I ARM Methodology and User's Manual should be replaced with the following:

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
ENTER NUMBER OF ACTIVE ATPS 6	
ENTER NUMBER OF ACTIVE ASPS 4	
TIME = 2160.05 ?	Current simulation time menu option
4	The RETURN option
TIME = 2160.1	This is the end of simulation time
SSG ARMPL.FREE, THEN SSG ARMPL. EDITYES	To remind the user. This now begins a process of editing data for following CI.
@ SSG ARMPL.FREE	Putting ARMPL.FREE into machine readable form.
SSG 20R1 S74T27	Machine reply
SGS	To input information to SSG.
FREE CI(N)	Tells machine which files to free.
@ END SSG ERRORS 0/0/0 RETAIN LEVEL 1.2	End of input files are now free and symmed to the printer
@ SSG ARMPL.EDITYES	Putting ARMPL.EDITYES into machine.
SSG 20R1574T27	Above entry processed to input CI nos to SSG.
EDIT CI(N), CI (N+1)	CI(N) to be edited and renamed CI(N+1)
@ XQT ARMPL.EDIT ZERO COUNTERS (YES or NO) YES ???	Execute the EDIT program EDIT menu option. This is now the same as in previous chapter Building and Editing data files.

ABSTRACT

This manual is one of a set of three, produced to document the Ammunition Resupply Model. The Ammunition Resupply Model (ARM) was designed to simulate those activities associated with ammunition resupply in parallel with the play of existing war games. Its purpose is to assess the capability of a given TOE structure to respond to the logistical demands placed upon it by various numbers of ammunition-expending weaponry and/or to assess the capability of existing or proposed resupply systems (i.e. number, location, or sizes of Ammunition Transfer Points (ATP) and Ammunition Storage Points (ASP)). This report contains a discussion of model methodology, data base development, interface requirement with the war game, and the operators guide. The second volume of the report is the Programmer's Manual, which consists of descriptions, logic flow diagrams, and the FORTRAN code of all the programs and routines associated with the Ammunition Resupply Model. The third volume contains a description of a standard heavy European Division data base along with data sources.

FOREWARD

In general, existing logistics models tend to address resupply requirements in aggregated terms, such as tons per man per day or rounds per tube per day. Although this approach has considerable merit for evaluating large force structures engaged in sustained combat, it is inadequate for addressing logistics impacts of organizations engaged in short, intense conflict scenarios.

Ammunition expenditures emerging from high level (as opposed to high resolution) war games have traditionally been either unconstrained or based on a percentage of an "anticipated" daily resupply capability. Because of this, support analyses have not been the product of a concurrent logistics simulation utilizing the same scenario, but have been based on evaluations made after game completion. This method can paint a false picture of a combat unit's effectiveness. The logistics system, especially its ability to resupply critical commodities such as ammunition and fuel, must be evaluated during the course of the simulated battle.

To derive meaningful insights into the effects of the ammunition resupply assets contained in different force structures and their impact on the combat effectiveness of the various units within the division, ammunition resupply must be evaluated in some detail. Such an evaluation must include simulating the time-consuming resupply process that places ammunition on individual weapon systems, as well as the movement of the different units' transportation assets to secure additional ammunition. It is this concept that provides the basis for the Ammunition Resupply Model (ARM), a concept that reflects the real-world factors that affect ammunition resupply. ARM was, therefore, developed to work in parallel with an associated war game.

The concept for ARM was developed in October-November 1978, with the methodology and logic flow charts being completed in December 1978. The actual coding of the model was accomplished from December 1978 through February 1979, and the model was operational in May 1979. In April, 1983 a major overhaul of the Structure of ARM was completed. This documentation reflects those changes.

ACKNOWLEDGEMENTS

The Ammunition Resupply Model (ARM) was initiated to study various ammunition resupply structures. These volumes represent documentation of ARM. This report has been approved by Commander, CACRA. The team included MAJ Allan Resnick, Mr Clyde Harris, Ms Ann Hills, Mr Richard Cunningham, and Ms Susan Solick. The team wishes to gratefully acknowledge the assistance of Mr. Donald E. Remen, MID, CACDA, and Douglas L. Tolin, C^3I, CACDA for their invaluable aid in the modification of ARM.

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Ammunition Resupply Model
Technical Manual

1. INTRODUCTION.

a. Purpose. The purpose of this report is to provide a detailed description of the Ammunition Resupply Model (ARM). This manual is an update of Technical Report TR 2-80 published by Directorate of Studies and Analysis, US Army Combined Arms Studies and Analysis Activity, Ft. Leavenworth, KS. ARM was developed to operate in parallel with a division level war game to study the ammunition resupply capability of alternative division organizations and alternative organizations of the resupply process (i.e. ASP and ATP configurations).

b. Scope. This report discusses the methodologies and data used in ARM along with the output (reports) generated. Included in this report is the Operators Manual, which outlines the procedure to be followed by the model operator in the execution of ARM.

c. Overview.

(1) General. ARM is an event oriented, time sequenced computer model developed to simulate the various functions associated with ammunition resupply from the Corps Storage Area (CSA) down to a given TOF structure to respond to the logistical demands placed upon it by various ammunition expenditures. It places these expenditures as demands on the resupply network. While actual processes inside ASPs and ATPs are only simulated by time delays, ARM does show shortfalls in the ammunition resupply system from these areas by subjecting constraints on the resupply of unit trucks due to availability of ammunition and material handling equipment (MHE) for loading. ARM forces the network to replace rounds on individual weapon systems and their accompanying vehicles at unit level and send unit trucks back to designated resupply points to fill up and return. The functions each truck must perform are broken into a series of discrete events (subroutines). The model takes each truck through a series of these event subroutines (with operational availability and interdiction considered) in which actions are completed and times accumulated. Helicopter resupply, interaction command decisions, and tactical realism can be incorporated during the game.

(2) Gamer Functions. The manual functions associated with ARM include finalizing of the data base from acquired map data for each game played, creation of associated events and distance files and the interactive operation of the console (see Chapter 6). Events files are used to set up future convoys for replenishment. Distance files set up for each increment of the war game contain road distances from units to servicing ATP, ATP number, distance to servicing ASP and ASP number.

(3) Game Resolution. ARM is a high resolution game that is capable of playing a brigade or division size force. Maneuver units are played at the battalion level, artillery and ADA units at the battery level, and aviation units at battalion or company level. Within the units, individual weapon systems (and any dedicated accompanying vehicle) are reloaded, and ammunition dedicated trucks deliver the ammunition to the systems and make runs to resupply points. A status of all units and of supply points (ATP's & ASP's) can be obtained at the end of a specified period of battle (usually 4 or 6 hours).

(4) Stand Alone Model. ARM was developed as a stand alone model in order to retain the flexibility to support a variety of attrition models. If the attrition model does not produce valid or usable ammunition expenditures, the capability exists within ARM to generate these demands. By using intensity levels (low, med, high) and type of engagement (attack, defend, delay) from the attrition model, demand for each unit can be created. Appendix A describes this demand generation methodology. Because ARM is an event-sequencing, time-stepped model which schedules events to occur at future times, it should not be integrated directly into the attrition model it is supporting.

2. ASSUMPTIONS/LIMITATIONS.

a. Maneuver units will have the opportunity to accomplish reload once during a specified period (4 or 6 hours) of combat, and anytime there is unsatisfied demand.

b. Artillery units will reload when low on ammunition, which is likely to be once each hour during the battle.

c. Aviation units will reload upon the return of the aircraft to the FARP.

d. Air defense artillery units will reload once during a specified period (4 or 6 hours) of combat.

e. Ammunition trucks are dedicated to carrying specified types of ammunition. Limited dual loading takes place. Artillery unit trucks also carry fuzes and powder on the same truck with the projectiles.

f. When a weapon system is lost all ammunition on the system is lost.

g. When a loaded truck is interdicted, the load is lost.

h. Helicopter emergency resupply will support only 155mm artillery batteries.

i. Helicopter resupply will originate from the ASP.

j. The division slice of corps heavy lift helicopters will not exceed 10 CH47s.

k. The division slice of corps transportation assets for ammunition resupply will be two medium truck companies of 60 tractors and 120 trailers each. These companies will provide ammunition through-put from the Corps Storage Area (CSA) to the ATPs and provide replenishment to the ASPs.

l. The model addresses the movement of ammunition from the Corps Storage Area (CSA) forward to the individual weapon systems.

m. Only five major types of ammunition for each unit can be played.

n. No current capability exists for playing missiles such as Pershing, Chapparrel, etc.

o. ARM can be used only in a defensive scenario unless alterations are made to replenishment logic.

p. Vehicle failure rates are assumed to be exponentially distributed; the repair time of a failed vehicle is log normally distributed.

q. ARM simulates the flow of ammunition resupply from the CSA forward. As such CSA stockages are always considered adequate.

3. METHODOLOGY.

a. General. The general concept for the ARM simulation is based on a description of the ammunition resupply policies within a division along with the ammunition through-put provided by the corps support units. A review of these policies reveals a series of discrete events (see figure 3-1). Ammunition expenditures during a battle generate demand for more ammunition. The ammunition trucks of the various units execute reload activities to replenish expended rounds on surviving weapons. When unit trucks become empty, they are sent to a rear ammunition resupply point for another load. The ammunition resupply point must have its stockage replenished in order to continually support the combat units. Essentially, ARM processes the ammunition expenditure developed by a war game or by independent demand generation and places this expenditure as a demand on the resupply network. It forces the network to replace rounds expended at unit level by requiring unit ammunition trucks to reload the surviving weapon systems and, when empty, to go to a designated resupply point, fill, and return. The model takes each truck through a series of discrete events (subroutines) (operational availability and interdiction considered) in which actions are completed and times are accumulated.

b. Major Events. The ammunition resupply network is broken down into four major events, each with a number of subroutines. These major events are demand, reload, resupply, and replenishment. Each will be discussed separately in order to facilitate understanding of the entire process as simulated in ARM.

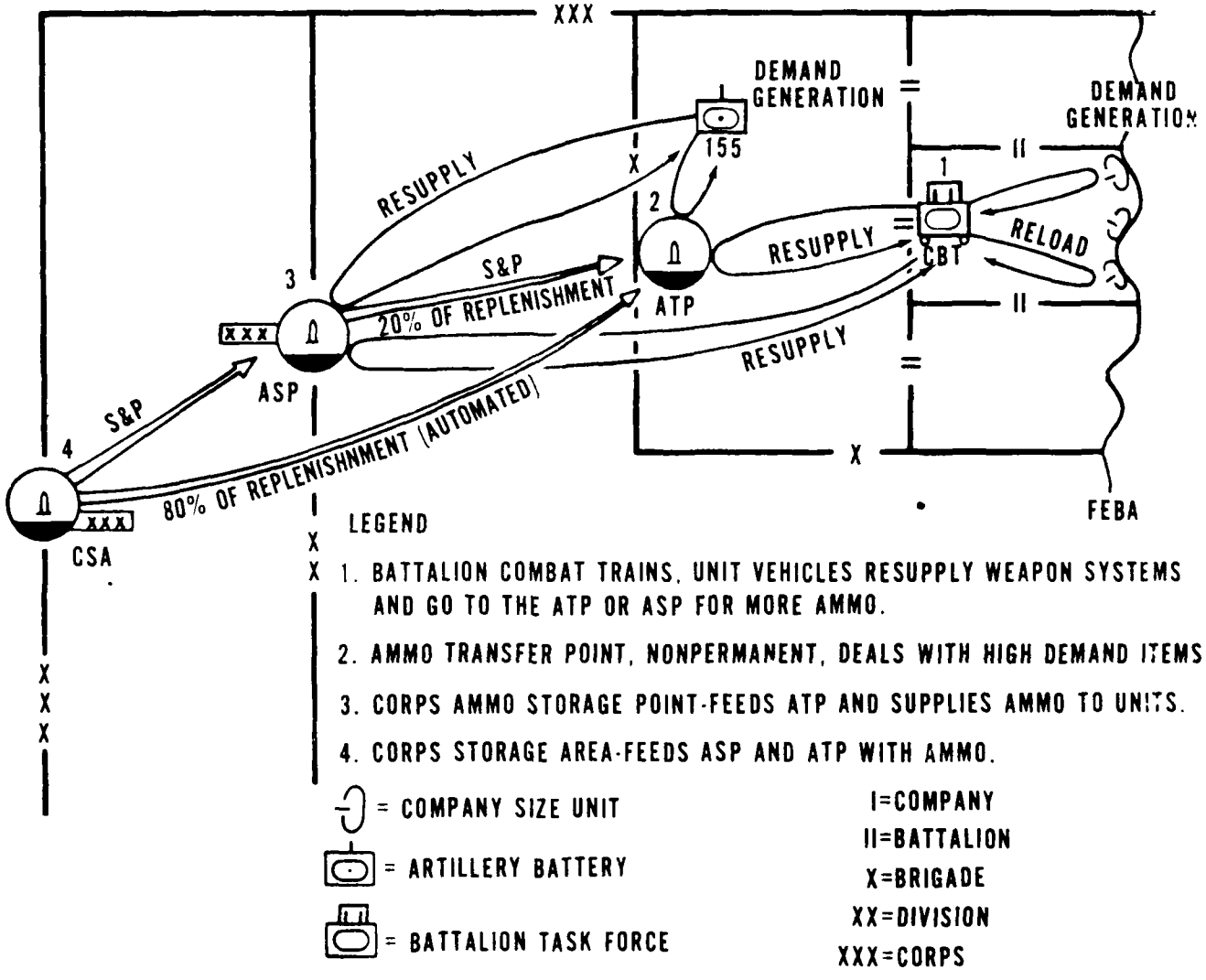

FIGURE 3-1 AMMUNITION RESUPPLY NETWORK

c. Demand and Reload. Figure 3-2 is a flow chart of the demand and reload processes. The following paragraphs describe major events included in this area.

(1) Demand. The demand for ammunition in ARM is provided as an input to the model from some opposing forces war game through subroutine RDJIFF. The input lists by unit the number of each weapon systems remaining alive, the number of survivors that actually fired, and the total rounds of ammunition fired by the survivers. Rounds fired by systems that were killed have been subtracted out. Weapon systems which are added to the battle are also reloaded. Within ARM the subroutine DEMAND performs the function of taking any unsatisfied demand of a unit (demand that has not been satisfied when the DEMAND event is called) and combining it with newly generated demand. If the unit is artillery, the total demand for each type of ammunition is divided by H to reflect the expenditure during each hour of the H hour critical incident of the war game for which ARM was developed. These pullses can be throught of as times when ARM looks to see if weapon systems need ammunition. The subroutine then scans the trucks at the unit to find one with the right ammunition. In the particular case of 155mm artillery units, DEMAND compares the actual demand (expenditure) against the sum of the current supply and the ammo-on-trucks. If the difference is unusually high (e.g., no trucks at the unit and current supply low) it is compared against the critical resupply level. If the critical resupply level has been reached, DEMAND will schedule an emergency reload event by helicopter (HELARV). If a truck was found with the correct ammunition on board a RELOAD event is scheduled. Upon completion of the DEMAND event, the unit's demand will have been updated and a reload event scheduled. For artillery units the DEMAND event will reschedule itself to occur again 60 minutes from the present time.

(2) Reload. For a given unit for which reload has been scheduled the subroutine RELOAD performs the actual replacement of rounds of ammunition expended by rounds carried on unit trucks. First a type of ammunition is selected, then the unit queue is searched for a truck hauling that type of ammunition. If a truck is found, the following calculations are made: (1) the number of weapon systems that can be reloaded by this truck - a function of the demand and the truck's load, (2) the total reload time, and (3) the return time to the combat trains or truck assembly area. The reload time is calculated by the following equation:

$$Rtime_{ijk} = 2 * Trvtme_{k} + W(A_i + B_j \ (\#Rds/Wpn))$$

where $Rtime_{ijk}$ = the time required to complete reload for weapons i with round j at unit k.

$TRVTME_K$ = travel time from combat trains or truck assembly areas to the weapon positions

W = number of weapons that can be loaded by a truck (depends on truck load)

A_i = set up time per weapon i (time for weapon to prepare itself to take on ammunition)

B_j = reload time per round (obtained from IRSTME file)

DEMAND AND RELOAD PROCESS (NAME OF ARM EVENTS/SUBROUTINES)

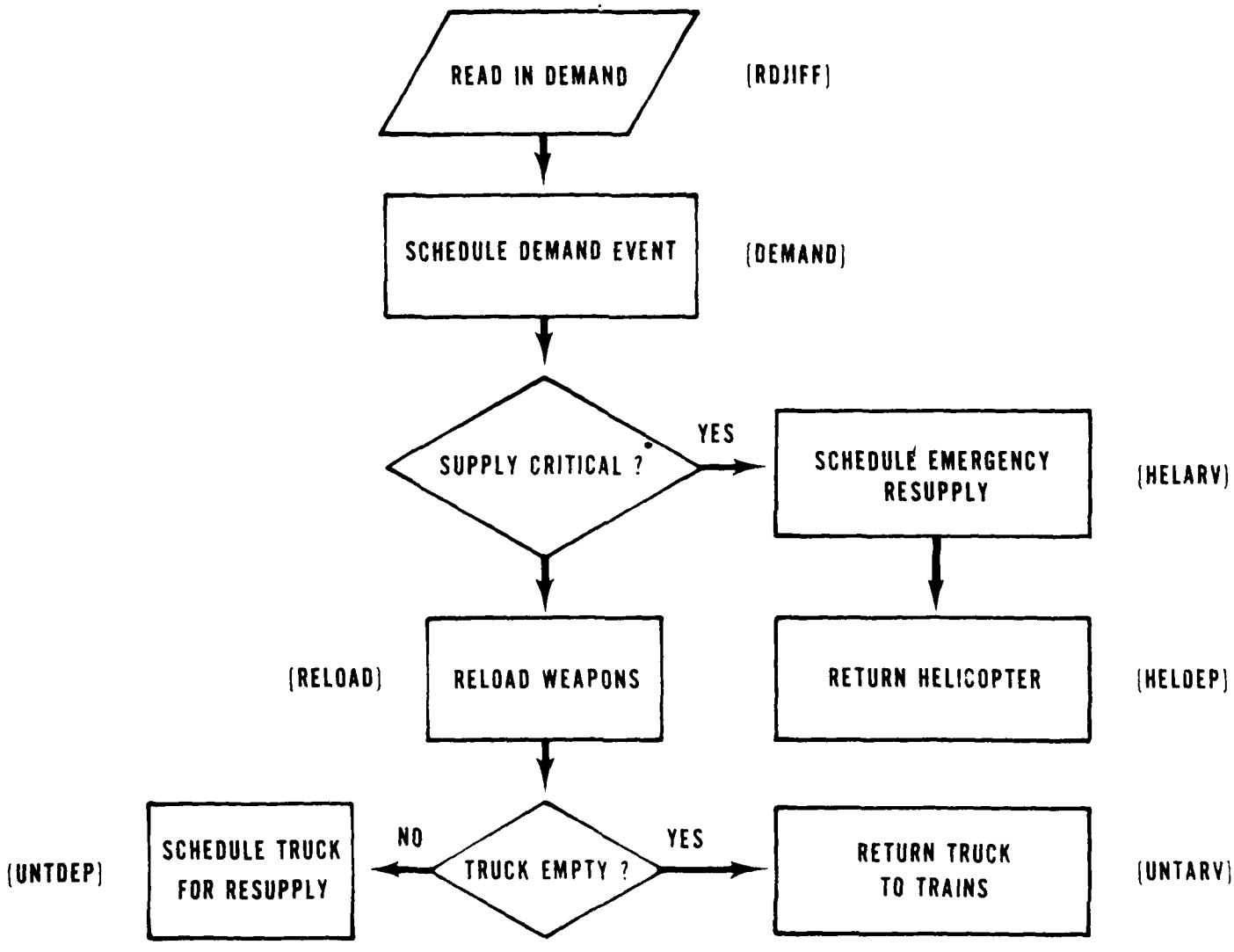

FIGURE 3-2 DEMAND AND RELOAD PROCESS

Having completed reload of the weapons the truck is scheduled to return to the combat trains or assembly area if there are rounds on board or it is scheduled to go pick up another load. Therefore, RELOAD will schedule a unit arrival (UNTARV), returning the truck to the unit to wait for another demand, or a unit departure (UNTDEP), sending it after another load.

(3) Unit Arrival (UNTARV). The subroutine UNTARV brings the truck back to the unit combat trains, in the case of maneuver units, or assembly areas for artillery units. Upon arrival, the ammo-on-truck, an element of the unit status, is updated. Since this event is scheduled from other subroutines, a check is made for unsatisfied demand of the particular type of ammunition carried on the truck. If there is an unsatisfied demand, a RELOAD event is immediately scheduled; otherwise, the truck waits for another RELOAD event to occur.

(4) Unit Departure (UNTDEP). If upon completion of a reload event a truck is empty, a unit departure (UNTDEP) event is scheduled. This subroutine checks for the type of ammunition in lowest supply. If this type is stocked at the ATP, an arrival time at the servicing ATP is calculated and an ATP arrival (ATPARV) event scheduled. The arrival time is based upon the distance from the unit to the ATP and the average speed of the truck. If the ammunition is not stocked at the ATP then an arrival time at the ASP is calculated and an ASP arrival (ASPARV) event scheduled.

(5) Operational Availability. Every time a truck moves, a check is made of its operational availability in subroutine OPERA. Each truck has its own clock, which keeps track of the hours of operation since it last failed. At the start of the game all trucks are initialized with a time since last failure based on an exponential distribution. Each time a truck moves, the time length of the move is subtracted from the time remaining until the next failure. When the time remaining becomes zero the truck status is changed and its movement delayed. The length of time a truck is inactive is based on a log normal distribution. OPERA is called from any event subroutine that involves truck movement and or activity (MHE).

(6) Interdiction. The interdiction subroutine (INTRDK) determines whether a truck about to execute a move will be interdicted and, if so, assesses a time delay for providing a replacement truck. For interdiction purposes, the combat arena is subdivided into two zones. Zone one extends from the line of contact to the brigade rear boundary. Zone two consists of the area from the brigade rear boundary to the corps storage area. Unit trucks forward of the ATP are considered to be in zone one, where they are susceptible to being hit by artillery fire. Unit trucks moving from the ATP to the ASP and all S&P type trucks are considered to move in zone two, where they are subject to attacks by aircraft. The attrition model provides the number of trucks killed by artillery fire during the battle being simulated. In order to determine which trucks are interdicted it is first necessary to take the total number of trucks killed, as given by the attrition model, and multiply it by the precentage of all trucks that carry ammunition. This number is then entered

into a data file as the total number of zone one trucks to be interdicted this battle period. In order to spread this number over as many units as possible, another number between 15 and 30 is selected at random, which is used as a controlled cycle number that we will call Y. Each time a truck is scheduled for move it is sent through INTRDK, where a counter is maintained. When the yth truck enters INTRDK it is the one interdicted, and a time delay is assessed before a replacement truck can be provided. The counter is then reset to 0 and started again. This procedure is continued until the total number of trucks that were to be interdicted has been reached. This method comes very close to representing reality since one would expect that units that fire often are more susceptible to receiving counterfire and therefore lose more trucks. In ARM, the units that fire more require the unit trucks to move more frequently. The number of trucks to be interdicted in zone two are selected by the military gamer. The number is usually less than the number of trucks interdicted in zone one. The delay time associated with interdiction is a constant representing average replacement time to division rear. Since 10-ton unit trucks are limited in inventory stockage, all interdicted 10-ton trucks are replaced with trucks having a 5-ton carrying capability.

d. Resupply. Figure 3-3 is a flow chart of the resupply process. Resupply of unit ammunition trucks consists of three distinct steps: (1) finding available ammunition (2) locating MHE to reload the truck (except for MLRS which will be discussed separately) (3) reloading of ammunition onto the unit truck. Since the most used types of ammunition are available at ATPs, the discussion of the resupply process will begin with a unit truck arriving at an ATP (subroutine ATPARV).

(1) Arrival at an ATP (ATPARV). The ATPARV subroutine determines the type of ammunition the arriving truck requires and the quantity of rounds needed. It then checks for availability of that ammo at the ATP. If supply is sufficient to service this truck and all other trucks already waiting for resupply of that ammunition type, the truck waits to be served. If the ammunition is an artillery type, a further check is made to make sure sufficient powder is on hand (ARM does not explicitly count fuzes for artillery ammunition). If the supply is insufficient to provide the truck with a load once it reaches the head of the line, it is sent to the ASP by scheduling an ASP arrival event (ASPARV). The time of arrival at the ASP is determined by distance between ATP and servicing ASP and average truck speed. If there are no other trucks waiting to be serviced, an ATP event is scheduled at that time, otherwise the truck waits at the bottom of the queue for the release of a server (MHE). In the case of trucks with organic cranes (currently MLRS carrying vehicles) a check is made to see the number of trucks at the ATP that are currently taking on MLRS. If there are less than three, an ATP event is scheduled; otherwise it must wait for a truck to finish its self-load. After a server (MHE) has been located to reload the unit trucks, an ATP event is scheduled.

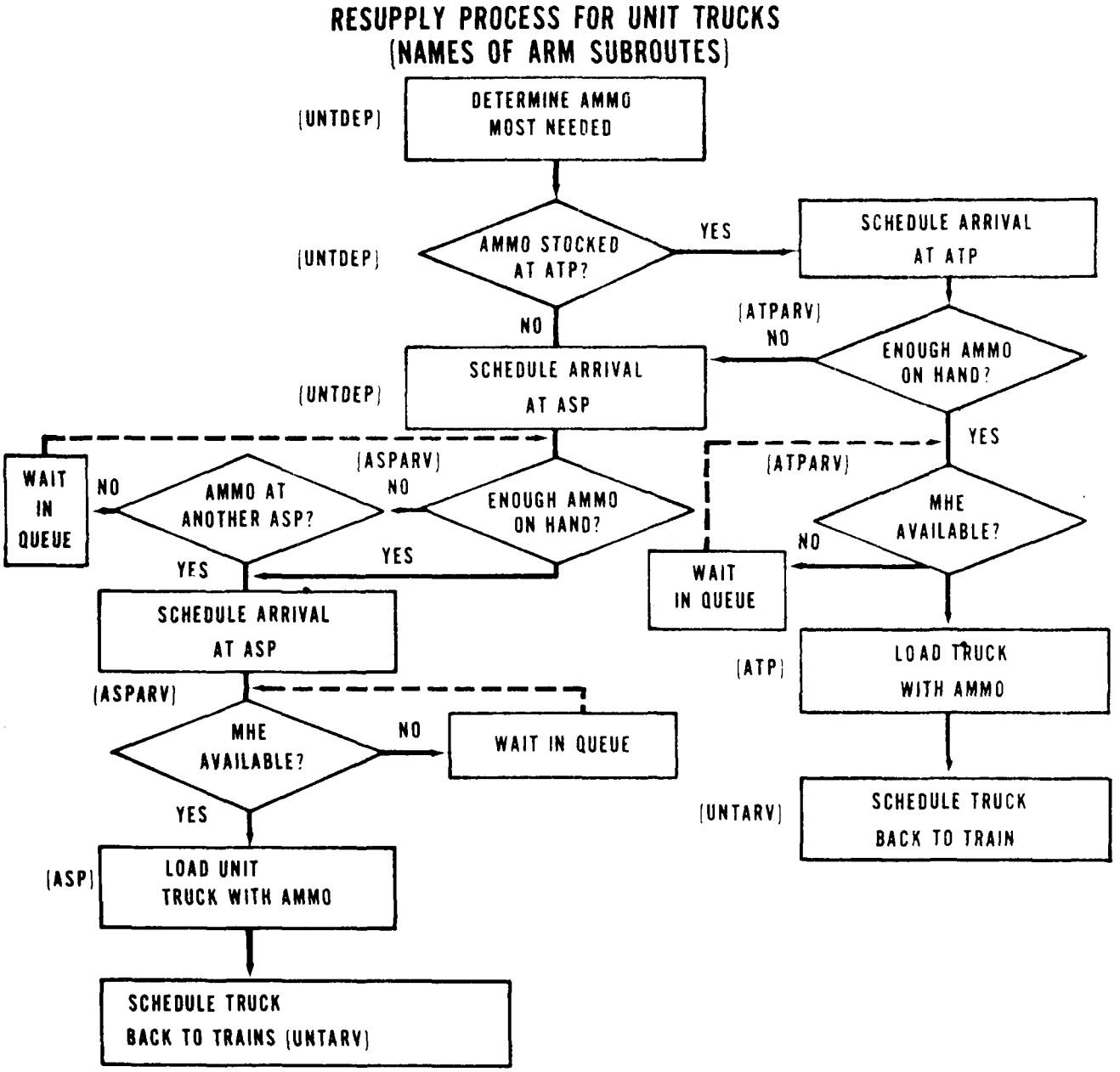

FIGURE 3-3 RESUPPLY PROCESS

(2) ATP Event. The ATP event (subroutine ATP) simulates activities which take place at the ATP. The event begins by locating an idle S&P trailer containing the type of ammunition needed. If no S&P is available for loading, i.e. all S&P with the correct ammunition are busy reloading other unit trucks, the truck waits. When an available S&P is located, the unit truck is loaded, the number of rounds loaded are decremented from the supply on the S&P, and rounds issued from the ATP are incremented. In the case of artillery ammunition, an S&P containing powder is also decremented. The loaded unit truck is then scheduled for arrival back at the unit (UNTARV). If the S&P trailer is empty, a tractor pulling a full trailer arriving for replenishment of the ATP will hitch up to the empty trailer and return it for restocking at the CSA or ASP (depending on its place of origin).

(3) Resupply at an ASP. Unit trucks are serviced at an ASP for one of three reasons: the desired ammunition is not stocked at the ATP; the truck was "bumped" from the servicing ATP due to lack of ammunition; this is a replacement for a unit truck which has been interdicted (all ammunition on an interdicted truck is lost).

(4) ASP Arrival (subroutine ASPARV). A unit truck arriving at an ASP follows essentially the same procedure as an arrival at an ATP. The major difference occurs when there is not sufficient ammunition at the ASP to resupply the unit truck. In this case a subroutine (ASPCK) is called which checks available ammunition at an adjoining ASP. If insufficient, then "rear" ASPs which are being established during the course of the war game are checked for availability. If supply is adequate at another ASP, then the unit truck is scheduled for an ASP arrival event at the correct ASP. If no ammunition is available at any ASP, the unit truck is held at the original ASP.

(5) ASP Event. An ASP event is similar to an ATP event except that ammunition is not only on S&P's, it is also stored on the ground, therefore, if no trailer is available, the unit truck is resupplied from ground stockage.

e. Replenishment. Replenishment of stockage at ASPs and ATPs are accomplished in ARM by the scheduling of convoys. Figures 3-4a and 3-4b are flow charts of the major replenishment activities. The reader should refer to it in reading the next paragraphs. Discussion will begin with ATP replenishment.

(1) ATP replenishment. In accordance with current plans, ARM supplies approximately 20 percent of stockage at ATPs from ASPs, 80 percent from the CSA. When a S&P trailer is emptied at the ATP, a determination is made (in Subroutine ATP) whether it originated at the ASP or the CSA, it is then put into the correct queue to wait for an incoming tractor. Figure 3-4a is a flow chart of major activities involved in replenishment of ATP supplies. Discussion of these activities will begin with an empty S&P trailer at the ATP. Determination is made whether this trailer originated at the servicing ASP or at the CSA.

REPLENISHMENT PROCESS FOR ATPS

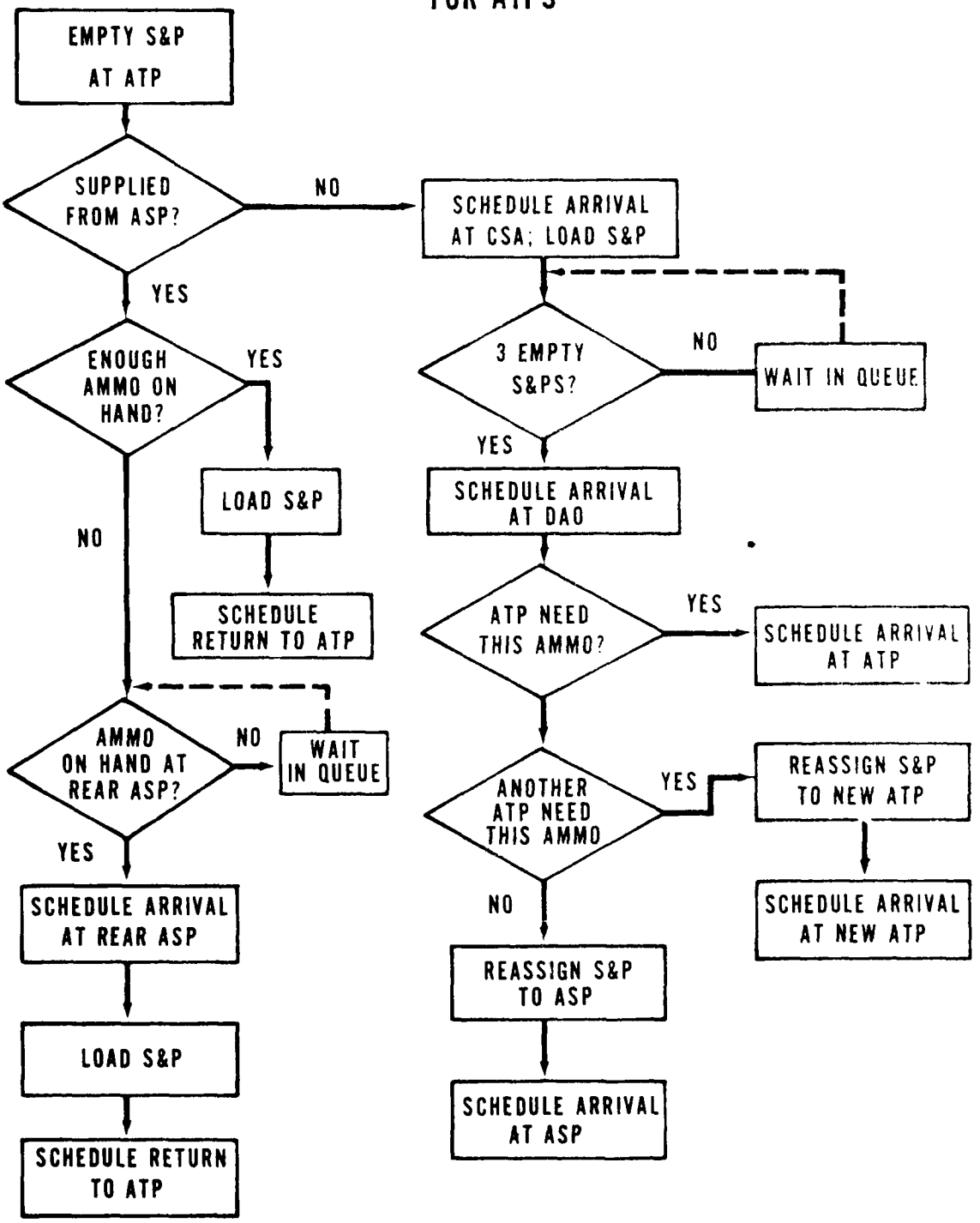

FIGURE 3-4a REPLENISHMENT

REPLENISHMENT PROCESS FOR ASP

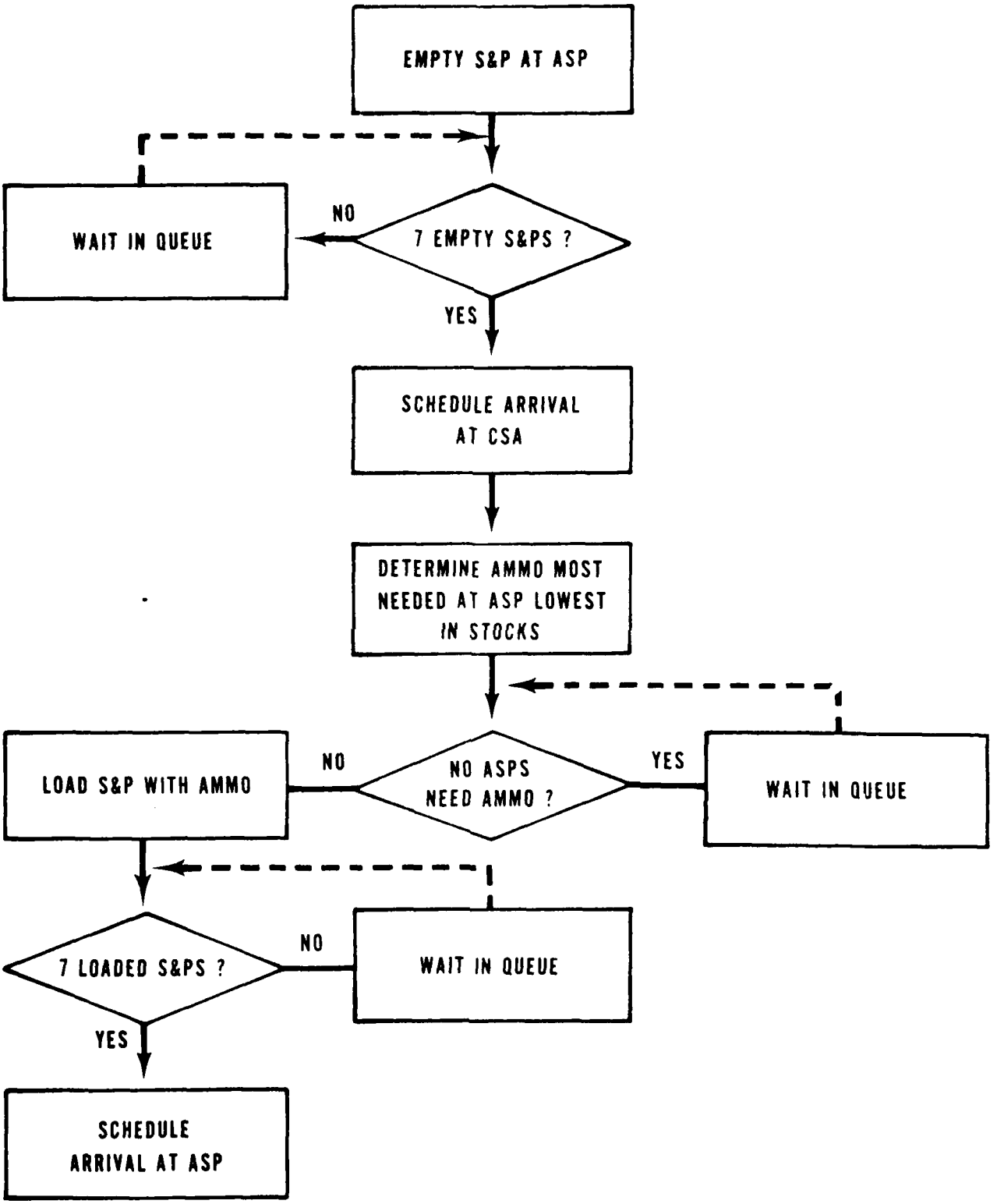

FIGURE 3-4 b REPLENISHMENT

(a) Replenishment from ASP. When a tractor carrying replenishment ammunition from the ASP to the ATP arrives at the ATP (subroutine ATPAR2), the rounds of the full tractor are added to the stockage at the ATP, an empty trailer is located and the S&P is then scheduled back to the ASP (Subroutine ASPAR1). At the ASP, a check is made to locate a full trailer of the correct ammunition. If one is found the tractor hitches up and is scheduled for return to the ATP with a time delay of 30 minutes for processing plus travel time back to the ATP; otherwise the empty trailer is filled and returned.

(b) Replenishment from CSA. Empty trailers are scheduled to return to the CSA (subroutine CSAARV) from the ATP through subroutine ATPAR1 when a tractor is available. Upon arrival at the CSA a delay time is assessed to simulate either location of a full trailer carrying the same ammunition or load time for an empty trailer. The vehicle is then held until three S&Ps are full and then a convoy of the 3 S&Ps are scheduled to depart the CSA (subroutine CSADEP) one minute apart. In order to simulate the activities of the Division Ammunition Officer (DAO), the S&P arrives at the DAO location (somewhere rear of the ATPs) at which time a check is made of the stockage objective for the type of ammunition the trailer is carrying at the assigned ATP. This stockage objective is input as part of the data base and should be adjusted as the game progresses to reflect shorter or longer distances between the ATP and CSA (and hence shorter or longer travel times for the S&Ps) which could result in too little or too much stockage at the ATP. If the stockage level at the assigned ATP has not been met, then the S&P is scheduled for arrival at that ATP. If stockage levels are already high at the assigned ATP, a determination is made whether other active ATPs need this ammunition, if so the S&P is diverted to the ATP needing supplies. If no ATPs need the ammunition it is sent to the assigned ASP.

(2) ASP replenishment. All replenishment of ASPs come from the CSA. Because of the length of time required to set up and stock an ASP, stockage of rearward ASPs is usually ongoing while active ASPs are replenished. When movement of the FEBA requires closing of an ASP, replenishment convoys are discontinued and existing stocks are utilized until depletion. Figure 3-4b is a flow chart of ASP replenishment logic in ARM.

(a) Storage of ammunition. An attempt is made to offload all ammunition onto the ground so that S&Ps can return to the CSA for more ammunition. When a full S&P arrives at the ASP (event ASPAR2), the ammunition on hand at the ASP is incremented. A search is made to see if the full trailer load is needed for stockage of ATPs, if so a delay to simulate unhitching and other related activities is assessed and the full S&P is returned to the ATP. The empty vehicle then waits until 7 empty S&Ps have accumulated when they are scheduled to arrive back at the CSA (event CSAARV) one minute apart. If the ammunition is not needed for stockage of ATPs, a search is made for an idle server to off-load ammunition onto the ground. If none are found, the S&P waits until one is available.

(b) Replenishment from the CSA. When an empty S&P arrives at the CSA, a check is made to determine which type of ammunition is most needed at any ASP which is receiving stockage. If all ASPs have achieved their stockage objective* for all Ammo types the truck waits at the CSA.

f. Corps Storage Area. ARM does not address replenishment of the CSA. Stockage of ammunition is always considered adequate. S&Ps are assessed time delays to simulate loading, but no discrete events take place nor is availability of MHE considered.

4. DEMAND GENERATION.

a. General. The RANMOD program was developed for two purposes: to generate the ammunition demand required by the ARM simulation and to facilitate the creation and modification of the ammunition demand files. Demand generation is based upon a 24-hour period which has been divided into two 12-hour phases (day and night). Each phase is comprised of several (1-3) critical incidents (CIs). In a given phase, a total demand figure will be generated for every active weapon system in each unit. Each of the total demand figures will then be distributed across the critical incidents comprising the phase and stored in the demand files.

b. Controlling Factors. The factors affecting demand generation include: weapon type, number of weapons short (weapons receiving ammunition), number of maintenance returns and war reserves, number of critical incidents comprising the phase, the type of phase, the MOPP level and battle intensity. The program obtains these factors through user input. As discussed in Appendix A, the weapon type and the unit battle intensity factor determine the high and low firing rates for each weapon system; the type of phase (day or night) and the MOPP level serve as degradation factors; and maintenance returns and war reserves determine the number of basic loads to add to the total combat demand. (It has been assumed that weapon systems added to a unit as war reserves arrive with no ammunition on board and maintenance returns arrive with 1/2 a basic load. Returns are made at the end of a critical incident (CI) and therefore do not expend any ammunition until the following CI.)

c. Demand Generation Process. The program retrieves the pertinent high and low limits from the Ammunition Consumption Windows** stored in the data section and takes their difference. A random number between 0 and 1 is drawn from a uniform distribution and multiplied by the difference. The lower consumption limit is then added, producing a demand figure for the total day, as in equation 1.

$$\text{total day demand} = (\text{high} - \text{low}) * \text{random draw} + \text{low limit} \qquad (1)$$

*See para (b) p 13 for discussion on Stockage Objectives.
**See Appendix A for explanation of consumption windows.

The total demand for a phase is then obtained by degrading the total day figure by the phase factor (.6 for day; .4 for night) and by the MOPP factor as in equation 2.

total phase = total day * phase factor * MOPP factor (2)

To distribute the total demand across the critical incidents (CIs) comprising the phase, a new random number is drawn for each critical incident. These CI draws are then summed and the proportion created by dividing a CI draw by the sum is multiplied by the total phase demand to determine the demand per tube, as in equation 3.

demand/tube = phase demand * CI draw/accumulated CI draw (3)

The demand per tube is then multiplied by the number of weapons short (weapons firing) to produce the total combat demand for that critical incident. Ammunition requirements are then assessed for the war reserves and maintenance returns and added to the combat demand: one basic load for each combat reserve and one-half basic load for each maintenance return. The resulting figure comprises the total demand, as in equation 4.

total demand = demand/tube * wpns short + (load * (war + mnt/2)) (4)

(1) Because Divad guns fire in 90 round bursts, total demand is rounded to the nearest integer divisible by 90.

(2) Because artillery weapons fire several types of ammunition, the total demand is distributed according to the distributions listed below:

	HE	ICM	RAP	CLGP	Other
155mm	0.16	0.65	0.11	0.04	0.04
8 in	0.20	0.68	0.12		

(3) For attack helicopter units, differences in operational techniques and employment methods necessitate a difference in demand generation. As described above, the difference between the high and low consumption windows is obtained, multiplied by a random number and added to the lower limit. This value is then multiplied by the number of helicopters flying missions in one critical incident and constitutes the total combat demand for that critical incident. MOPP and phase degradation factors are not applied; maintenance returns and combat reserves are calculated as above to determine the total demand, as in equation 5.

ah demand = ((h-1)*draw+1) * wpns sht + (load(war+mnt/2)) (5)

d. Ammunition Demand Files. The demand files are direct access files each dedicated to one critical incident and consisting of a list of attributes for each unit used in ARM. Each unit in the file represents one record of the file.

(1) The unit attributes may be viewed as a 5x6 matrix in which each row represents a different ammunition type and each column contains a different ammunition feature (ammunition code, number of weapons alive, weapons short, attack helicopters per cell, total demand):

UNIT	AMMO CODE	WPNS LIVE	WPNS SHRT	AHS/ CELL	TOTAL DEMAND
FA-2ACR	4	7	7	0	140
	5	7	7	0	564
	11	7	7	0	95
	12	7	7	0	35
	13	7	7	0	35
	0	0	0	0	0

Currently, each file contains thirty attributes for each of the seventy-five units listed in ARM. Up to fifty-five such files (one for each of the fifty-five critical incidents) can be created without program modification.

(2) RANMOD accesses the demand files through the use of an SSG runstream (RUNS). The runstream assigns the permanent files and permits multiple versions (cycles) of each file to co-exist. The RANMOD program reads from the writes to the files assigned by the runstream.

e. Editing Features.

(1) An integral part of the editing process is the INFO routine. INFO is an internal reference routine which provides access to specific information during program execution. The success of the editing process is dependent upon the accuracy and judgment involved in user responses to program queries. Incorporated into each major query is the parenthetical comment (INFO = ___). If the user enters the INFO value in response to the query, a message containing information pertinent to that query will be displayed. For example, the INFO message in response to a query for a weapon system code will display the list of available systems by name and code number; the INFO response to an option query will explain the effect of each of the options listed.

(2) There are four fundamental operations available: print file; copy sequence; change-by-row; and edit/new demand.

(a) The print file operation offers the choice of having the files printed locally or not. When printed locally, the user can select specific units to be listed. The listing will give the unit attributes for the entire phase. When the other alternative is selected, each file is read into a report file to be synmed to a specific location for later printing. The report file will be retained for later reference.

(b) The copy sequence operation is designed to allow the user to copy one sequence (of one or more units) into another within the same file.

(c) Change-by-row is a hand-insert method used for modifying portions (rows) of units in individual files. The primary editing process operates at the phase level, manipulating values for several files at one time. Change-by-row permits the user to alter the values in one critical incident without affecting the values in the remainder of the phase. A copy feature also provides the only means for copying individual rows into new units without disturbing the values in the remainder of the unit.

(d) The edit/new demand operation is the main editing process of the program. It operates on an option-selection basis, permitting the user to select only those options desired. Twelve options are available:

1. Weapons alive
2. Weapons short
3. Weapon type
4. Attack helicopters
5. Maintenance returns
6. War reserves
7. Instant demand
8. Unit copy
9. Auto list
10. Auto save
11. New demand
12. By ammo code

The first seven consist of different types of entries which may need to be made; the next four consist of different functions that can be performed; the last provides the user with a method of selecting specific ammunition types to alter. The user can select any combination of the twelve which suits his needs. The user instructions that follow provide a step-by-step illustration of how this process works.

f. User Instructions. User instructions are divided into two columns. The left-hand column contains program messages and sample user responses. User responses are underlined, program messages and machine prompts are not. The right-hand column contains explanatory remarks.

PROGRAM MESSAGES AND USER RESPONSES	COMMENTS
@SSG DEMAND RUNS	The SSG runstream will access the permanent demand files.
SSG . . .05/23/83 12:54:21	
SGS	
NUMCIS 3	The number of files to be edited is entered. This number should be equal to the number of CIs in the phase (1, 2, or 3). Here, 3 CIs will be edited.

PROGRAM MESSAGES AND USER RESPONSES	COMMENTS
REPORT	Report is entered when the user intends to create a printable file of the data files. Following the completion of the editing process, the report files can be symmed to a printer for listing.
	The user now must select one of two methods:
NEW 01, 02, 03	The NEW method is used when no files exist to be read. Here, demand files for CIs 01, 02, and 03 will be created.
or	
OLDFILE 01, 02, 03 NEWFILE 01, 02, 03	This method allows the user to copy from existing files into new files. In this example, the old file 01 will be read into a new cycle of file 01 and into a new file 03. The old file 13 will be read into file 02. (Note: the file numbers are two-digit numbers between 01 and 55 which correspond to the actual CI numbers involved.)
@	This entry indicates that all required information has been entered.
END SSG. ERRORS: /0/0/0	
.	
.	
.	
READY	The number of READY prompts will depend
READY	upon the number of CIs involved and the
READY	method selected above.
.	
.	
.	
.	
	The user is now ready to begin execution of the editing program, RANMOD.
@XQT DEMAND.RANMOD	
ENTER FILE TREATMENT.(INFO=0) 1. New files from old 2. New files from scratch. 3. Copy sections.	Select the treatment which is appropriate to the SSG runstream.

PROGRAM MESSAGES AND USER RESPONSES	COMMENTS
0	This entry will list the INFO message.
(1) is used when creating a new file or cycle from an old file. (2) is used with the NEW option in the SSG runstream. (3) would be used in the rare instances when only part of an old file is to be copied into the new one	
2	The second option is selected.
ENTER THE NO. OF CIS AND EACH CI NO. (INFO=0,0)	The first entry gives the numbers of files to be edited. The remaining entries are used only for printouts and will not affect the files.
3, 1, 2, 3	There will be 3 CIs and they will be labeled CI 1, CI 2, and CI 3.
ENTER METHOD TO BE USED. (INFO=0)	
1. Units in sequence	Permits work on a series of units.
2. Random units	Permits work on individual units in any order.
3. Group	Attributes of the first unit will be copied into every unit of the specified sequence.
1	User has selected the first option.
ENTER FIRST AND LAST UNIT NOS. (INFO=0,0)	
17 36	The user has selected the sequence from unit 17 to unit 36 for editing.
STATUS OF OPTIONS: (1=Change, 0=Stay Same) 1. Wpns alive = 1 2. Wpns short = 1 3. Wpn type = 1 . . . 10. Auto save = 1 11. New demand = 1	The STATUS menu displays the available options and their normal setting (0 or 1) The user can change the setting of any option by entering its number. The information message will provide an explanation of each option listed.

PROGRAM MESSAGES AND USER RESPONSES	COMMENTS
TO ALTER STATUS ENTER ITEM NO. (0=None; Info=99)	
10	This entry will cause the auto save option (10) to be reset to 0. Thus, rather than have the unit values written directly into the file automatically, the user will be polled [SAVE?(1=yes)] following each unit.
0	This entry designates the end of status changes. The options set up for the unit sequence 17-36 will now be polled, one weapon and one unit at a time.
FOR WPN NO 1 OF UNIT 17, ENTER THE FOLLOWING:	
THE WPN SYSTEM NUMBER IS: (INFO=99)	The information response will list the weapon systems available.
9	(9) is the number of the 155mm howitzer.
NO. OF WPNS ALIVE PER CI: (NONE=0; INFO=99. .)	Prompts specifying responses "per CI" require one separate entry for each CI.
99 0 0	This entry causes the following message to be listed.
Wpns alive are to be entered for each CI separately. To zero out the remainder of a unit for the entire phase (all CIs involved) user must enter 9999 as 1st entry and any nos. for remaining entries..	
8 7 9	Eight weapons alive are assigned for the first CI, seven for the second and 9 for the third.
NO. OF WPNS RECEIVING AMMO PER CI:	For artillery weapons only, more weapons can receive ammunition than are listed as alive.
8 9 12	

PROGRAM MESSAGES AND USER RESPONSES	COMMENTS
CURRENT DEMAND FACTORS: 1. MOPP=100 2. INTENSITY=1 3. PHASE=1 4. NEW RETS=0	The demand factors (1, 2, 4) can vary from unit to unit. The current values are displayed before generating the demand for the first weapon of each unit or copy.
ENTER FACTOR AND NEW VALUE (NONE=0,0; INFO=),FACTOR)	Values will remain at their last setting until changed.
2 2	Intensity is set to 2 and will remain equal to 2 until a new value is entered.
0,4	This entry will cause the information message for factor no. 4 to be listed:
New rets shows if war reserves or mnt rets have already been entered (0=no; 4=yes). If more returns are desired, user enters one of the following: 1=war; 2=mnt; 3=both).	
4,2	The program is set to prompt for maintenance returns.
0,0	No more changes will be made.
ENTER THE NO. OF MNT RETS PER CI:	This prompt is in response to demand factor 4.
4,5,0	The demand generated will have 4 mnt loads added in the first CI, 5 mnt loads added in the second CI, and none added in the third.
	New demand for this weapon is generated at this point.
	Following the completion of one weapon for non-artillery units, the program will query, NXT WPN?(1=yes). If yes, the program will return to "FOR WPN NO. 2 OF UNIT 17, ENTER THE FOLLOWING," and continue until the unit is filled or the user responds, "no". For howitzer units the array is filled by the first entry and demand generated for the entire unit at one time.

PROGRAM MESSAGES AND USER RESPONSES	COMMENTS
FA 12 ACR 4 7 8 0 140 . . . 5 7 8 0 564 . . . 11 7 8 0 95 . . . 12 7 8 0 35 . . . 13 7 8 0 35 . . . 0 0 0 0 0 . . .	When a unit has been completed the results are displayed.
LIST THE UNIT STATS? (1=YES)	The unit statistics contain data which will not be saved, such as the no. of returns, the phase level and the intensity.
9	Unit statistics will not be listed.
SAVE? (1=YES)	Because the automatic save option was reset, the program now prompts the user.
1	The data generated is then written into the file. For artillery units, the save routine will automatically set the weapons short column equal to weapons alive column as is required by the ARM model. The program will now fetch the next unit in the sequence and return to the promot, "FOR WPN 1 OF UNIT 18..." This process will repeat until the last unit in the sequence has been completed or the user has escaped by entering 9999 as the first wpn alive.
WHAT NEXT? (INFO=0) 1=Continue method 2=Change method 3=Copy units 4=New run 5=Print modified file 6=End	The program will now prompt the user for his next action.
6	User has elected to end the program run.
THE PROGRAM IS NOW FINISHED.	
@RETAIN @SYM,U LOGRPT01 @SYM,U LOGRPT02 @SYM,U LOGRPT03	User now frees the files. The reports are now placed in line to be printed at the assigned printer.

5. DATA BASE DEVELOPMENT.

a. Overview. Prior to processing a series of CIs through ARM, several steps are necessary. One of these is the preparation of the demand input, presented in Chapter 4. It is the purpose of this chapter to address the remaining steps. Therefore, this chapter will include the presentation of a data base description or dictionary; the establishment of an initial ARM base; instructions for building and modifying the main ARM data base; and instructions for building and editing event and distance files.

b. Data Base Description. Within the ARM package is a non-executable subroutine called INFORM. It consists of a brief description of the arrays and variables which comprise the ARM data base. The following is based upon that information. Instructions establishing the data values and for building and editing these files on the computer are given in paragraph 5c and 5d of this chapter. The ARM user will have to become familiar with these files and establish the data values. Sample values as well as their sources for a European Heavy Division 86 are given in Volume III.

(1) Unit Data. Following are the unit data arrays. In ARM units are generally played at the battery level for artillery and at the battalion level for maneuver units. The arrays or variables which must be addressed by the user are flagged with an asterisk (*).

(a) *IUNIT (75,142) - Up to 75 ammo using units of 142 words each. Most of the words or attributes are used to describe the up to ten types of ammunition a unit might use.

Word	Description
1	Unit type (Eight types of units, explained following IUNIT description).
2	Servicing ATP of the unit.
3	Servicing ASP of the unit.
4	Distance from the combat trains or assembly area to ATP (KM).
5	Distance from the combat trains or assembly area to ASP (KM).
6	Time the last truck was interdicted for this unit.
7	Helicopter missions received by the unit this CI.
8	First ammo type. The 20 types are listed at 5b(5)(a).
9	Number of weapons alive, first ammo type.
10	Number weapons short ammo, first ammo type.
11	Number rounds short-all weapons, first ammo type.
12	Current ammo supply-all weapons, first ammo type. (Basic load on the weapons alive minus the rounds short).
13	Routine supply level-per weapon, first ammo type. (75% of basic load ammo level-word 15, the level of ammunition stockage on the weapon at which resupply would be initiated given an opportunity to resupply).
14	Critical resupply level-per weapon, first ammo type. (Level of ammunition stockage on the weapon at which resupply must be initiated in order to sustain firing).

15	Basic ammo level-per weapon, first ammo type. (Stockage of ammo on the weapon system itself and/or the tracked carrier associated with an artillery tube).
16	Ammo on trucks, first ammo type. (Lists the number of rounds bulk loaded on the unit ammo trucks. It represents the bulk loaded portion of the true basic load).
17	Number of weapons killed at the end of CI, first ammo type. (Input from the Wargame each CI and is used to reduce the original number of weapon systems alive).
18	Number of weapons short ammo, first ammo type. (Used to determine the reload requirements per weapon based upon total rounds short).
19	Total rounds demanded through whole CI, first ammo type. (Input from the Wargame each CI and is used as the demand on the resupply network).
20	Storage for number of rounds resupply in route, first ammo type. (Attributes 21-137 describe the up to nine other types of ammo used by a unit. In describing a MLRS unit, for example only one type of ammo is fired so only attributes 8-19 are used).
21-33	As above, for second ammo type, in attributes 8-20.
34-46	As above, for third ammo type.
47-59	As above, for fourth ammo type.
60-72	As above, for fifth ammo type.
73-85	As above, for sixth ammo type. (currently not used)
86-98	As above, for seventh ammo type. (currently not used)
99-111	As above, for eighth ammo type. (currently not used)
112-124	As above, for ninth ammo type. (currently not used)
125-137	As above, for tenth ammo type. (currently not used)
138	Number of helicopters missions assigned. (Only for 155mm units. Used to determine whether or not a unit has received its maximum number of helicopter resupply missions this CI).
139	= 0, if single pulse demand per CI. (If reload of rounds fired is accomplished once during the CI). = 1, if multiple pulse demand per CI. (For artillery units the total CI demand is divided by the number of hours in the CI and that amount is resupplied each hour of the CI).
140-142	Counters. (Computed and used internal to ARM program).

(b) Explanation of unit type codes, word 1 of IUNIT.

Code	Unit Type
1	Tank Task Force.
2	Mechanized Task Force.
3	Armored Cavalry Squadron.
4	155 Artillery Battery.
5	8-inch Artillery Battery.
6	MLRS Battery.
7	DIVAD Gun Platoon.
8	Combat Aviation Platoon.

(c) AUNIT (75,2) - 75 units, 2 alpha fields per unit. Word 1 is usually left blank as the computer does nothing with it and it might cause classification problems.

Word	Description
1	UTM coordinates. (Identifies unit map position).
2	Alpha unit names. (Unit name as it appears in wargame).

(d) Explanation of MLRS queue server counters. These counters are used by the program and are not entered by the operator. They refer to the number of MLRS that can be reloading at a supply point at any one time (a maximum of three).

Server Counter	Description
1	Number of failures.
2	Number of S&P offloads.
3	Number of ASP-ATP S&P load ups.
4	Number of 5 ton load ups.
5	Number of 10 ton load ups.
6	Number of load ups from CSA S&Ps.
7-8	Not used.

(2) Truck Data.

(a) *ITRUCK (1400,15) - For all vehicles, 1400 trucks with 15 words each as follows:

Word	Description
1	Truck type (Explained following truck arrays).
2	Mission type (Explained following truck arrays).
3	Status type (Explained following truck arrays).
4	Owner number. (The ARM number identifying a particular unit).
5	Ammo mix number//Server off-load time at ASP. (The number that identifies the types of ammo hauled by the truck. Defined in IMIX, section 5b(5)(b)).
6	Percent loaded//Server load time. (Percent of ammo load on truck at a given point in time - not usually entered except initially, calculated by program).
7	Time since last failure (MIN). (Used to determine the time the truck will break down by subtracting from it all subsequent movement times. Established for all trucks at the beginning of the game by multiplying MTBF for each type truck by a random number from 0-1).

(8-15 are general truck counters concerning unit, CSA-ATP, CSA-ASP, ASP-ATP. They are used by the program and not addressed by the user).

Truck Counters:			UNIT	CSA-ATP	CSA-ASP	AST-ATP
8	1	# failures.				
9	2	# interdictions.				
10	3	# Arrivals from:	ASP/ATP Reloads	CSA	CSA	ASP Thru-puts
11	4			#at CSA	# at CSA	at ASP
12	5	Queue time.	ASP/ATP Bmpd	CSA	CSA	At ASP (MIN)
13	6		To 2d ASP	Time Mt in ATP/ASPQ		
14	7		Bmpd to ASP	# Empty @ ASP		Bmpd to rear
15	8		.GT. 3 in MLRS Q			ASP

(b) Explanation of truck type codes.

Code	Truck Type
1	10 ton.
2	5 ton.
3	5 ton with a 1 1/2 ton trailer.
4	10 ton with a 10 ton trailer (MLRS).
5	22 ton S&P.
6	Helicopter.
7	Goer.
8	Rough terrain forklift.
9	Crane.

(c) Explanation of truck mission type codes.

Code	Mission
1	Unit truck.
2	CSA-ATP link.
3	CSA-ASP link.
4	ASP-ATP link.
5	ASP-unit (helicopter).
6	ATP server.
7	ASP server.
8	Not used.
9	Bumped to rear of system ASP.

(d) Explanation of truck status type codes.

Code	Truck Status
1	In unit queue - or available if truck is acting as server.
2	In ATP queue.
3	In ASP queue.
4	In transit - or busy if truck is acting as server.
5	Unit truck going from ATP to ASP - server moving to new location.
6	Truck awaiting repair.
7	Truck dead (interdicted).
8	In CSA queue.
9	Bumped to 2d ASP - server of interdicted ASP/ATP.

(e) *ITYPE(9,6) - speed and maintenance data for vehicles. 9 truck types, 6 words for each type, as follows:

Word	Description
1	Secondary road night speed (unit to ASP, ATP) (KM/HR).
2	Secondary road day speed (unit to ASP, ATP).
3	Highway night speed (KM/HR). (CSA-ASP).
4	Highway day speed (KM/HR). (CSA-ASP).
5	MTBF (MIN). (Mean time before failure).
6	MTTR (MIN). (Mean time to repair).

(f) Queue list. Truck queues 1-176 are described as follows:

Truck Queue	Queue Type	Description
1-75	1	At each unit.
76-85	2	At ATPs for CSA-ATP S&Ps.
86-95	3	At ATPs for ASP-ATP S&Ps.
96-105	4	At ATPs for unit artillery server.
106-115	5	At ATPs for unit maneuver server.
116-125	6	At ATPs for servers.
126-135	7	At ASPs for CSA-ASP S&Ps.
136-145	8	At ASPs for routine unit trucks.
146-155	9	At ASPs for MLRS unit trucks.
156-165	10	At ASPs for servers.
166-175	11	At ASPs for ASP-ATP S&Ps.
176	12	At CSA for CSA S&Ps.

(3) ATP Data.

(a) *IATP (10,53) - General ATP data for 10 ATPs, 53 words each as follows:

Word	Description
1	Distance to CSA (KM).
2	Distance to ASP (KM).
3	Distance to DAO (KM).
4	Not used.
5	Number of arriving S&P tractors used for return of empty trailers.
6	Associated ASP number.
7	Queue for ASP S&P. (Explained at 5b(2)(f), Queue list).
8	Number of MLRS trucks being served.
9	Queue for CSA S&P. (Explained at 5b(2)(f)).
10	Server's queue number. (Explained at 5b(2)(f)).
11	Artillery queue number. (Explained at 5b(2)(f)).
12	Maneuver unit queue number. (Explained at 5b(2)(f)).
13	Convoy counter at CSA (If greater than or equal to 3, schedules convoy forward).

Word	Description
14	Number of trucks in artillery queue.
15	Number of trucks in maneuver unit queue. (Explained at 5b (2)(f)).
16	Server removal counter.
17	Number of convoys sent from CSA.
18-19	Not used.
20	Number of times a server is not available.
21	Current ammo supply, ammo number 1.
22	Queue ammo demand, ammo number 1.
23	Ammo on-the-way (from DAO), ammo number 1.
24-26	Same as 21-23, for ammo number 2
27-29	ammo number 3
30-32	ammo number 4
33-35	ammo number 5
36-38	ammo number 6
39-41	ammo number 7
42-44	ammo number 8
45-47	ammo number 9
48-50	ammo number 10
51	fuzes
52-53	Not used.

(b) *IATPSD (5) - ATP service data, 5 words as follows:

Word	Description
1	Lowest ASP-ATP round-robin S&P number.
2	ATP first priority S&P queue.
3	ATP 2d priority S&P queue.
4	CFA ATP owner number.
5	Not used.

(c) IATPSP (10,22) - Used to obtain ASP % replenishment, 10 ATPs with 22 words each, as follows:

Word	Description
1-11	Number of CSA S&Ps arriving, by ammo type.
12-22	Number of ASP S&Ps arriving, by ammo type.

(d) IATPAM (10,40) - Ammo removed from ATP for 10 ATPs and 10 ammo types, as follows:

Word	Description
1-10	Number of 10 ton trucks serviced (MLRS with trailer).
11-20	Number of 5 ton trucks serviced (MLRS without trailer).
21-30	Number of 10 ton trucks bumped.
31-40	Number of 5 ton trucks bumped.

(e) JATP (10,6) - For the 10 ATPs, as follows:

Word	Description
1	Number of trucks served by the maneuver queue.
2	Total queue wait time for all trucks served (MIN).
3	Maximum wait time for the maneuver queue (MIN).
4	Trucks served through the artillery queue.
5	Total queue wait time for all queues served (MIN).
6	Maximum wait time for the artillery queue (MIN).

(4) ASP Data.

(a) *IASP (10,110) - This general ASP data concerns 10 ASPs described by 110 words each as follows:

Word	Description
1	Distance to CSA (KM).
2	ASP status (-1 inactive, 0 active/no convoys, 1 active/convoys).
3	Cumulative helicopter counter.
4	Queue for CSA-ASP S&P trucks. (Explained at 5b(2)(f)).
5	Number of trucks to CSA.
6	Number of empty S&Ps at ASP.
7	Server's queue number. (Explained at 5b(2)(f)).
8	Number of MLRS being served.
9	Routine queue number. (Explained at 5b(2)(f)).
10	MLRS queue number. (Explained at 5b(2)(f)).
11	Rear ASP number.
12	Number of trucks in routine queue.
13	Number of trucks in MLRS queue.
14	Convoy counter at CSA (If greater than or equal to 7, schedule convoy forward).
15	Helicopter server counter.
16	Server removal counter.
17	Number of convoy sent from CSA.
18	Queue for ASP-ATP round-robin S&Ps. (Explained at 5b(2)(f)).
19	Not used.
20	Number of times a server is not available for a unit truck.
21	Current ammo supply, ammo number 1.
22	Queue ammo demand, ammo number 1.
23	Ammo on-the-way (from CSA or DAO), ammo number 1.
24-110	Same as words 21-23 for ammo 2-30.

(b) IASPSP (10,30) - Used to store S&P arrivals by ammo type, for 10 ASPs and 30 ammo types.

(c) JASP(10,9) - For the 10 ASPs, as follows:

Word	Description
1	Trucks served through the routine queue.
2	Total wait time for all trucks served (MIN).
3	Maximum wait time in the routine queue (MIN).
4	Trucks served through the MLRS queue.
5	Total wait time for all trucks served (MIN).
6	Maximum wait time in the MLRS queue (MIN).
7	Trucks served through the ASP-ATP queue.
8	Total wait time for all trucks served (MIN).
9	Maximum wait time in the ASP-ATP queue (MIN).

(d) IASPAM (10, 120) - Ammo removed from ASP for 10 ASPs and 30 ammo types, as follows:

Word	Description
1-30	Number of 10 ton trucks serviced.
31-60	Number of 5 ton trucks serviced.
61-70	Number of ATP S&Ps serviced.
71-80	Number of CSA-ATP arrivals.
90	Number of helicopter loads removed.
91-120	Number of CSA-ASP S&Ps arrived.

(e) *IAMLVL(2,30) - stockage level objectives for up to 10 ATPs and 30 ASPs, as follows:

Word	Description
1,1-28	ATP stockage objectives.
2,1-30	ASP stockage objectives.
1,29	Maximum ATP stockage %.
1,30	Maximum ASP stockage %.

(f) *ISERV(10) - Used for server manipulations, as follows:

Word	Description
1	Number of ATP servers to be held (As for displacement - all ATPs).
2	Number of ASP servers to be held (As for displacement - all ASPs).
3	ATP server hold queue.
4	ASP server hold queue.
5	Number of interdicted ATP.
6	Number of interdicted ASP.
7	Minutes servers to be held in hold queue at ATP.
8	Minutes servers to be held in hold queue at ASP.
9-10	Not used.

(5) Ammo Data.

(a) Ammo type codes - the 20 ammo type codes are as follows:

Code	Description
1	105mm (M60-A3/XM1).
2	TOW.
3	Powder canisters. (For 155mm FA).
4	155mm HE.
5	155mm ICMDP.
6	8-inch HE.
7	8-inch ICMDP.
8	8-inch powder.
9	Hellfire.
10	MLRS.
11	155mm RAP.
12	155mm CLGP.
13	155mm smoke.
14	30mm (AAH).
15	8-inch RAP.
16	Mortar.
17	Bushmaster.
18	DIVAD.
19	Small arms.
20	Fuzes.

(b) *IMIX(91,32) - Ammo mix quantities and load times. 91 ammo mixes (1-30, 10-ton mixes; 31-60, 5-ton mixes; 61-90, S&P mixes; 91, helicopter mixes), 32 words for each mix. For each of up to 30 ammo codes used in ARM this file contains one or more mix numbers. Each mix number represents the number of rounds of that type ammnition that can be hauled on a particular truck type. Attributes 31 and 32 provide the load time for this quantity of rounds at the ATP and ASP, respectively.

Word	Description
1-30	Number of rounds of each ammo type.
31	Load time at CSA/ATP (MIN).
32	Load time at ASP (MIN).

(6) Miscellaneous Data.

(a) Event scheduling.

COMMON/EVENTS/JSTAT(6), JEVDS(2048,4), IEVS(5,2048) - These arrays are used in ARM to perform internal bookkeeping type functions.

(b) Queue data.

COMMON/QUENUM/IHEAD(176) - Head of truck queue.
COMMON/QUEPNT/ITEMS(1400) - Trucks in queue.

(c) Interdiction data.

COMMON *INTER(10)

Word	Description
1	Counter for zone 1 trucks killed in INTRDK.
2	Counter for zone 2 trucks killed in INTRDK.
3	Number of trucks to be killed in zone 1.
4	Number of trucks to be killed in zone 2.
5	Time to replace truck in zone 1.
6	Time to replace truck in zone 2.
7	Modulo of trucks to be killed in zone 1.
8	Modulo of trucks to be killed in zone 2.
9	Number of zone 1 trucks entering INTRDK.
10	Number of zone 2 trucks entering INTRDK.

(d) *IDAY

1 = Day, 0 = Night

(e) ICSA(3,32) - Number of rounds from CSA by ammo type, as follows:

(1,1-11) Number of S&Ps to ATP.
(2,1-30) Number of S&Ps to ASP.
(3,1-30) Cumulative ammo demand of all units.
(1,30) Ammo types.
(2,31) Counter for empty S&Ps at CSA.
(3,32) Counter for empty POL trucks at CSA.

(f) *LPPAR(8) - System parameters. Values in parentheses may be varied depending upon scenario, though some program modification might be required.

Word	Description
1	Total number of ammo codes (20). (Maximum number at an ASP).
2	Number of ammo codes at ATP (10).
3	Number of maneuver unit ammo codes at ATP (3).
4	Number of transports (trucks) (Less than 1400).
5	Number of helicopters available (10).
6	Number of ammo types at units (Less than or equal to 10).
7	Number to subtract from 5-ton mix to get ammo type. (20).
8	Number to subtract from S&P mix to get ammo type. (60).

(g) *TCIST - Time of start of CI in decimal minutes (TCIST must be .0005 for CI01).

(h) *TCILNG - Time length of CI in decimal minutes.

(i) *TIME - Current simulation time in decimal minutes.

(j) *LUOUT - Refers to the unit number of where the ARM audit trail is being written. Should be set and left at value of "2". Transfers output to a file which can then be printed out.

(k) JUNIT(8,24) - Truck data for 8 unit types, as follows:

Word	Description
1	Number of trucks sent to the ATP from the unit.
2	Number of trucks killed on that move.
3	Number of trucks failed on that move.
4	Total travel time for all trucks on that move.
5	Number of trucks sent to the ASP from the unit.
6	Number of trucks killed on that move.
7	Number of trucks failed on that move.
8	Total travel time for all trucks on that move (MIN).
9	Number of trucks sent to the ASP from the ATP.
10	Number killed on that move.
11	Number failed on that move.
12	Total travel time for all trucks on that move. (MIN).
13	Number of trucks sent to the unit from the ATP.
14	Number killed on that move.
15	Number failed on that move.
16	Total travel time for all trucks on that move (MIN).
17	Number of trucks sent to the unit from the ASP.
18	Not used.
19	Number failed on that move.
20	Total travel time for all trucks on that move (MIN).
21	Total time spent in reloading weapons (MIN).
22	Total time available for unit trucks (MIN).
23	Number of trucks killed during reload.
24	Not used.

l) *IRSTME(23,3) - Resupply time data for 23 ammo types, 3 words each, as follows:

Word	Description
1	Weapon set-up time (MIN). (Time it takes a weapon system to be prepared to take on ammo once the ammo truck arrives in the area of the weapon).

2 Load time per round (MIN/1000). (The average time it takes to uncase a round and store it on the weapon system).

3 Travel time to weapon (MIN). (One-way travel time from the truck assembly area or combat trains to the weapon system. It is computed based on the approximate distance that the trucks are likely to be from the weapon systems they support and the travel speed of the truck. Travel speed is calculated as the average speed for 50% cross country and 50% secondary roads.

(m) Event Types - The 19 ARM events, their 5 parameters, and their descriptions are: (Note - parameter 5 is also the event type number)

EVENT	(1)	(2)	(3)	(4)	(5)	DESCRIPTION
DEMAND	UNIT #				1	Checks ammo demand of units
RELOAD	UNIT #	TK #			2	Replaces rds of ammo at unit wpns
UNTDEP	UNIT #	TK #			3	Departure of TK from unit
ATPARV	UNIT #	TK #	ATP #		4	Arr or unit TK at ATP
ASPARV	UNIT #	TK #	ASP #	mix	5	Arr of unit TK at ASP
ATP	1=ARTY Q 2=MAN Q	ATP #	TK #	SVR #	6	Svc of TK from Q at ATP
ASP	1=Routine Q 2=MLRS Q	ASP #	TK #	SVR #	7	Svc of TK from ASP Q
UNTARV	UNIT #	TK #			8	Arr of TK at unit
CSAARV	ATP/ASP #	S&P #	ASP #	0 - ATP 1 - ASP	9	Arr of S&P at CSA
ATPAR1	ATP #	S&P #	ASP #	0/555 - rtn from reload	10	Arr of S&P from CSA
ATPAR2	ATP #	S&P #	ASP #	0/55 rtn from reload	11	Arr of S&P from ASP
ASPAR1	ATP #	S&P #	ASP #		12	Arr of ASP S&D at ASP (from ATP)

EVENT	(1)	(2)	(3)	(4)	(5)	DESCRIPTION
ASPAR2	ASP #	S&P #			13	Arr of S&P TF at ASP from CSA
HELARV	UNIT #	HELI #			14	Arr of Heli at unit
HASPAR	None	HELI #			15	Arr of Heli back at ASP
CSADEP	ATP/ASP #	S&P #			16	Departure of S&P to ASP/ATP
REPORT					17	Writes reports
CONTROL	8888	8888	8888	8888	18	
ENDSIM	9999	9999	9999	9999	19	

c. Establishing the Initial ARM Data Base. Taking an initial data base such as that shown in Vol III, a data base for any scenario can be established by applying suitable modifications to it. This requires changes to be applied to all or some of the values appearing in the arrays/variables: IATP, IASP, IUNIT, ITRUCK, ITYPE, IMIX, IAMLVL, IATPSD, IDAY, TCIST, TCLNG, TIME, IHOUT, IRSTME, IMIX, INTER, LPPAR, and ISERV. These arrays/variables will be addressed now in the order they appear on the data base printout. Where the numbers are derived and in some cases what the numbers should be will be discussed, but the main emphasis will be on the general source of where the numbers come from. A fuller discussion of outside data sources will be found in Volume III.

(1) IATP (10,53)-defined in section 5b(3)(a). Values for each of these up to 10 ATPs used must be set for the 53 attributes as follows.

Attribute 1-3 are the road distances in KM to the CSA, ASP, and DAO, respectively. Positions of units, CSA, ASP, and DAO are set in accordance with the scenario and doctrine.

Attribute 4 is not used.

Attribute 5 is the number of arriving S&P tractors used for return of empty trailers. This value is left for the user to decide in accordance with a specific scenario.

Attribute 6 is the ASP serviced by this ATP. ATPs have been numbered from 1-10, while ASPs are numbered from 11-14 in this example. This is a user decision.

Attribute 7 is the queue for ASP S&P. This should be set to zero.

Attribute 8 is the number of MLRS trucks being served. This should be set to zero.

Attribute 9 is the queue for CSA S&P. This should be set to zero.

Attribute 10 is the server's queue number. These are assigned number 116-125 for ATPs 1-10, as per queue list 5b(2)(f).

Attribute 11 is the artillery queue number, numbers 96-105 from the queue list.

Attribute 12 is the maneuver unit queue number, numbers 106-125 from the queue list.

Attribute 13 is the convoy counter at CSA. This should be zero.

Attribute 14 is the number of trucks in the artillery queue. This should be set to zero.

Attribute 15 is the number of trucks in the maneuver unit queue. This should be set to zero.

Attribute 16 is the server removal counter. This should be set to zero.

Attribute 17 is the number of convoys sent from CSA. This should be set to zero.

Attribute 18-19 are not used.

Attribute 20 is the number of times a server is not available. This should be set to zero.

Attribute 21 is the current ammo supply of ammo number 1. This is the user's decision.

Attribute 22 is the queue ammo demand, ammo number 1. This should be set to zero.

Attribute 23 is ammo-on-the-way (from DAO) for ammo number 1. This should be set to zero.

Attribute 24-26, 27-29,..., 48-50 are the same variables as attributes 21-23, but for ammo number 2, 3,..., 10.

Attribute 51 is the number of fuzes at the ATP. User's choice.

Attributes 52-53 are not used.

(2) IASP (10,110)-defined in section 5b(4)(a). Values for each of the up to 10 ASPs used should be set for the 110 attributes as follows:

Attribute 1 is the road distance to the CSA in KM. Should be set in accordance with scenario and doctrine.

Attribute 2 is the ASP status (= - 1 if inactive, = 0 if active/no convoys, = 1 active convoys). Should set active ASPs to 1, inactive ASPs to -1, 0 when desiring to deactivate the ASP.

Attribute 3 is the cumulative helicopter counter. Should be zeroed initially.

Attribute 4 is the queue for CSA-ASP trucks. Should be set according to queue list.

Attribute 5 is the number of trucks to CSA. Should be set to zero.

Attribute 6 is the number of empty S&Ps at ASP. Should be set to zero.

Attribute 7 is the server's queue number. Should be set according to queue list.

Attribute 8 is the number of MLRS being served. Should be set to zero.

Attribute 9 is the routine queue number. Set according to queue list.

Attribute 10 is the MLRS queue number. Set by the queue list.

Attribute 11 is the rear ASP number. User's decision, based upon his scenario.

Attribute 12 is the number of trucks in the routine queue. This should be set to zero.

Attribute 13 is the number of trucks in MLRS queue. Set to zero.

Attribute 14 is the convoy counter at CSA. Set to zero.

Attribute 15 is the helicopter server counter. Set to zero.

Attribute 16 is the server removal counter. Set to zero.

Attribute 17 is the number of convoy sent from CSA. Set to zero.

Attribute 18 is the queue for ASP-ATP round-robin S&Ps. Set from queue list.

Attribute 19 is not used.

Attribute 20 is the number of times a server is not available for a unit truck. Set to zero.

Attribute 21 is the current ammo supply, ammo number 1. User sets according to scenario.

Attribute 22 is the queue ammo demand, ammo number 1. Set to zero.

Attribute 23 is the ammo-on-the-way (from DAO or CSA), ammo number 1. Set to zero.

Attributes 24-110 are the same as attributes 21-23, for ammo types 2-30.

(3) IUNIT (75,142)-defined at 5b(1)(a). Values for each of the up to 75 units.

Attribute 1 is the unit type, determined from the unit type codes, section 5b(1)(b).

Attribute 2 is the number of the unit's serving ATP. Set by user from scenario.

Attribute 3 is the number of the unit's servicing [illegible]. Set by user from scenario.

Attributes 4-5 are the road distances in KM to the unit's ATP and ASP, respectively. All positions are set in accordance with scenario and doctrine.

Attribute 6 is the time the last truck was interdicted for this unit. Should be initialized to zero.

Attribute 7 is the helicopter missions received by the unit this CI. Set to zero.

Attribute 8 is the number of the first ammo type, determined from the ammo type codes, section 5b(5)(a).

Attribute 9 is the number of weapons alive which fire the first ammo type in that unit. Set according to scenario. Usually the number of tubes firing this ammo in a battery or battalion for maneuver unit.

Attribute 10 is the number of weapons short, first ammo type. Set to zero.

Attribute 11 is the number of rounds short for all the weapons, first ammo type. Set to zero.

Attribute 12 is the current ammo supply for all weapons, first ammo type. Set to the total basic load of all weapons firing this ammo in the unit.

Attribute 13 is the routine resupply level per weapon, first ammo type. Set to 75% of basic load for a weapon.

Attribute 14 is the critical resupply level per weapon, first ammo type. User may set according to doctrine employed. Note - used only for 155 artillery units, for other units set to zero.

Attribute 15 is the basic ammo level per weapon, first ammo type. Depends on weapon type.

Attribute 16 is the ammo on trucks, first ammo type. This is the bulk loaded-on trucks-portion of the true basic load. Depends on weapon and truck type.

Attribute 17 is the number of weapons killed at the end of the CI, first ammo type. Set to zero.

Attribute 18 is the number of weapons short ammo, first ammo type. Set to zero.

Attribute 19 is the total rounds demanded through the whole CI, first ammo type. Set to zero.

Attribute 20 is the storage for number of rounds resupply in route, first ammo type. Set to zero.

Attribute 21-137 are the same as attributes 8-20 for ammo types 2-10.

Attribute 138 is the number of helicopter missions assigned for 155mm units emergency resupply. Set to zero.

Attribute 139 equals zero if resupply happens once per CI. It is set equal to one if resupply is desired each hour of the CI, the amount being equal to the demand divided by the number of hours in the CI. The "pulsed" demands are usually used for artillery and aviation units.

(4) ITRUCK (1400,15)-defined at 5b(2)(a). The 15 attributes for the up to 1400 trucks should be filled as follows:

Attribute 1 is the truck type, defined in section 5b(2)(b).

Attribute 2 is the mission type, defined in section 5b(2)(c).

Attribute 3 is the status type, defined in section 5b(2)(d).

Attribute 4 is the number of the unit to which the truck is assigned. User and scenario dependent.

Attribute 5 is the ammo mix number, determined from IMIX in section 5b(5)(b).

Attribute 6 is the percent loaded on the truck. Should usually be set to 10,000 initially (which represents 100%).

Attribute 7 is the time since last failure. Set to zero.

Attribute 8-15 are counters. Set to zero.

(5) IMIX (91,32)-defined at 5b(5)(b). 91 mixes with 32 words for each mix. Of the 32 words the first 30 refer to ammo types 1-30. Mixes 1-30 are 10-ton mixes, 31-60 are 5-ton mixes; 61-90 are S&P mixes; 91, helicopter mixes. IMIX is filled as follows:

Attribute 1-30 are the number of rounds of each ammo type the truck will carry.

Attribute 31 is the load time in minutes at CSA/ATP. Scenario dependent, based on MMCS data.

Attribute 32 is the load time in minutes at ASP. Scenario dependent, based on MMCS data.

(6) IAMLVL (2,30)-defined at 5b(4)(e). Two stock level objectives for up to 10 ATPs and 30 ASPs and 30 ammo types as follows:

Attributes (1, 1), (1, 2),...(1, 20) are the ATP stockage objectives for up to 30 ammo types. These are the amounts of each ammo type the ATP will try to maintain throughout the simulation. Scenario dependent.

Attributes (2, 1), (2, 2),...,(2, 30) are the ASP stockage objectives. These are the ammo levels each ASP will try to maintain during the simulation. Scenario dependent.

Attribute (1,31) is the load time in minutes at the CSA/ATP. Scenario dependent and based on MMCS data.

Attribute (1,32) is the load time in minutes at the ASP. Scenario dependent and based on MMCS data.

(7) IATPSD(5)-defined in section 5b(3)(b). Five words of ATP service data, filled as follows:

Attribute 1 is the lowest ASP-ATP round-robin S&P number. Set by the user to correspond to the appropriate truck number from ITRUCK.

Attribute 2 is the ATP first priority S&P queue. User and scenario dependent.

Attribute 3 is the ATP second priority S&P queue. User and scenario dependent.

Attribute 4 is the CFA ATP owner number. User choice in accordance with scenario.

Attribute 5 is not used.

(8) IDAY-flag which equals 1 for daytime CI or 0 for night CI. Scenario dependent.

(9) TCIST-time of start of CI in decimal minutes. Set at .0005 initially. More generally it is the ending time of the previous CI.

(10) TCILNG-time of length of CI in decimal minutes. Usually 240 minutes for day CI and 360 minutes for night CI.

(11) TIME-current simulation time in decimal minutes. Set at zero initially.

(12) LUOUT-a flag that directs output to specific devices. Should be set at 2 to begin runs.

(13) IRSTME (23,3)-defined in section 5b(6)(1) is resupply time data for 23 ammo types, 3 attributes, filled as follows:

Attribute 1 is the weapon set-up time in minutes. This is the time it takes a weapon system to be prepared to take on ammo once the ammo truck arrives in the weapons area. Scenario dependent.

Attribute 2 is the load time per round in minutes/1000. Scenario dependent.

Attribute 3 is the one way travel time-in minutes-to weapon. It's computed based on the approximate distance that the trucks are likely to be from the weapons systems they support and the travel speed of the truck for 50% cross country and 50% secondary roads. Scenario dependent.

(14) ITYPE (9,6)-defined at 5b(2)(e), speed and maintenance data for 9 vehicle types, 6 attributes each, filled as follows:

Attribute 1 is the secondary road night speed in KPH. This is scenario dependent. Used for determining arrival time of a unit truck at ATP or ASP at night. For truck types 8 and 9 this has been reserved for the standard deviation of MTTR for 5/10 ton trucks and S&Ps, respectively.

Attribute 2 is the secondary road day speed in KPH. Scenario dependent. Used for determining arrival time of a unit truck at ATP or ASP during the day.

Attribute 3 is the highway night speed in KPH. Scenario dependent. Used in calculating the arrival time of an S&P truck traveling at night.

Attribute 4 is the highway day speed in KPH. Scenario dependent. The speed of an S&P truck on a highway during the day.

Attribute 5 is the mean time between failures vehicle type dependent. Log Center data.

Attribute 6 is the mean time to repair. Vehicle type dependent. Log Center data.

(15) INTER (10)-defined at 5b(6)(c). 10 words filled as follows:

Attributes 1-2 are the counters for zone 1 and 2 trucks killed, respectively. Set to zero. Unit trucks forward of ATP are in zone 1, others in zone 2.

Attributes 3-4 are the number of trucks killed in zone 1 and 2, respectively. Scenario dependent.

Attributes 5-6 are the replacement times for trucks lost in zone 1 and 2, respectively. Scenario dependent.

Attributes 7-8 are the modulo of trucks to be killed in zone 1 and 2, respectively. Everytime a truck enters the zone it is counted. When this count reaches the modulo number that truck is interdicted. User decision, based on the number of trucks killed and the number in the zone.

Attributes 9-10 are the number of zone 1 and 2 trucks entering routine INTRDK. Initialize to zero.

(16) LPPAR(8)-defined at section 5b(6)(f), system parameters, all scenario dependent, set as follows:

Attribute 1 is the total number of ammo codes, up to 30 for this version of ARM.

Attribute 2 is the number of ammo codes at ATP, up to 10 for this version of ARM. Scenario and doctrine dependent.

Attribute 3 is the maneuver unit ammo codes at ATP, up to 3 for this version of ARM. Scenario and doctrine dependent.

Attribute 4 is the number of trucks, up to 1400 for this version of ARM.

Attribute 5 is the number of helicopters available, up to 10 for this version of ARM.

Attribute 6 is the number of ammo types at units, up to 10 for this version of ARM.

Attribute 7 is the number to subtract from 5-ton mix to get ammo type. Based upon how numbers have been previously assigned.

Attribute 8 is the number to subtract from S&P mix to get ammo type. Based upon how numbers have been previously assigned.

(17) ISERV (10)-defined at 5b(4)(f), 10 words used for server manipulation and counting. If desired, all may be initialized to zero.

Attribute 1 is the number of servers in each ATP to be held. In case ATP is being displaced, this is all servers. Otherwise, the user may choose a number up to the maximum number of servers. Used when simulating shutting down of ATPs or movement of ATPs.

Attribute 2 is the number of ASP servers to be held. In case ASP is being displaced, all servers. Otherwise, the user may choose a number up to the maximum number of servers. Used when simulating shutting down of ASPs or movement of ASPs.

Attributes 3-4 are the ATP and ASP hold queues, respectively. User choice, consistent with the queue list and the first 2 attributes.

Attributes 5-6 are the number of interdicted ATP and ASP, respectively. One of each may be interdicted as scenario dictates.

Attributes 7-8 are the minutes servers are to be held in the hold queue at ATP and ASP, respectively. User decision. Amount of time ATP or ASP is shut down or on the move.

Attributes 9-10 are not used.

d. Building and Editing Data Files. ARM data bases are initialized and edited using the EDIT program. Though not an absolute necessity, during the initialization process, it is advantageous to begin with a sample data base such as that described in Volume III. This allows the operator to use an existing data base printout and with the data base description and section 5c make penciled changes for use as an input sheet. This is the procedure described herein. The data base is printed out in the order shown in section 5c. The arrays/variables are listed in the order: IATP, IASP, IUNIT, ITRUCK, ITYPE, IMIX, IAMLVL, IATPSD, IDAY, TCIST, TCILNG, TIME, IUOUT, IRSTME, IMIX, INTER, LPPAR, and ISERV. Having made the changes necessary on the printout, the user is then ready to enter them at the computer terminal. The suggested procedure is to enter the changes in the order they appear on the printout. Examples of how to make such entries are the purpose of this section. It should be remembered that in most real applications the process is more lengthy than it may appear here. These instructions are for the initial data base. Editing the data base in later CIs is done as described in Chapter 6, Running a CI.

The following instructions are displayed in two columns. The first contains an ordered list of user responses. The user responses have been underlined for emphasis though they should not be when actually running the program. They are the information the user enters at the computer terminal. The system messages may be informational in nature or they may be prompts, asking the user to respond to certain options. The second column consists of any clarifying remarks concerning what appears in the first column. None of these remarks are actually displayed to the user. The instructions assume the user being already logged on to a UNIVAC System 1100 computer at a CRT terminal. For further information concerning the 1100 Executive Control Language and/or its Symbolic Stream Generator (SSG) the user is referred to the applicable UNIVAC documentation. More information pertaining to the ARM subroutine descriptions and executive language runstreams is located in Volume II of this documentation.

USER INSTRUCTIONS FOR BUILDING AND EDITING
MAIN ARM DATA FILES

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@ASG,UP TDATABCI01(+1).	Makes the file TDATABCI01(+1)., which is to be input to EDIT, available for use on this run.
READY	System message that previous statement has been processed and system is ready for next.
@COPY DATABCI01.,TDATABCI01(+1).	Transfers a copy of the already existing data base, DATABCI01., into TDATABCI01(+1).
FURPUR 28R3 S74T11 04/07/83 13:44:35 24 Blocks copied	Files are successfully copied.
@FREE TDATABCI01(+1).	Frees file from the run.
READY	
@SSG ARMPL.EDITYES	SSG control statement is used to put ARMPL.EDITYES into machine readable card images.
SSG 20R1 S74T27 03/08/83 08:46:09	The SSG has been invoked at this date and time.
SGS	Provides information for use by the SSG.
EDIT CI00,CI01	The CI00 data base is to be edited to produce a new data base, CI01, for the first CI.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@XQT ARMPL.EDIT	ARMPL.EDIT execution is begun.
END SSG.ERRORS:/0/0/0 TIME: 3.578 STORAGE: 6336/0/ 6368/053777 LINES: 9/9 RETAIN LEVEL 1.2 READY READY READY READY READY READY READY READY	The SSG process has been completed with no errors detected.
ZERO COUNTERS? (YES or NO)	An affirmative answer will zero counters in INTER, ISERV, IATP, ISASP, and set TCIST to the current game time. Also TCILNG is set to a standard of 240 minutes. A negative response is entered when building the initial data base. Thereafter, a positive response is given.
N	
Modify INTER, IDAY, TCILNG, ASP STATUS ???	A system message reminding the user it is now time to begin performing editing functions. A menu of editing options may be requested by entering a "9" here. Should the user already be familiar with the menu he can begin editing directly by entering the number for the desired option.
9	Editing menu request.
(1)-EDIT DATA FILES (2)-UPDATE FA CURRENT SUPPLY (TO 100 Percent) (3)-CLOSE ATP (4)-MODIFY TRK QUEUES (5)-PRINT TRUCK QUEUES (6)-STOP	

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
???	
1	An explanation of the options now follows, beginning with EDIT DATA FILES. The user may now access the data elements from the data base description.
VARIABLE NAME =	The variable of interest may now be addressed.
ITRUCK 17	The seventeenth element of the array ITRUCK is now available.
..	User commands are the LIST or L, the CHANGE or C, and the LEAP or SKIP. The two periods indicate the system is waiting for a command.
L 2	The user has asked to see the second attribute of ITRUCK 17.
ITRUCK 17 ATTRIBUTE 2 = (value)	The requested value is printed on the screen where the parentheses indicate.
IUNIT 22 23	
..	
L 4 5	Here the user has requested display of IUNIT 22 and IUNIT 23, attributes 4 and 5.
..	
IUNIT 22 ATTRIBUTE 4 = (value) ATTRIBUTE 5 = (value)	The requested display is shown.
IUNIT 23 ATTRIBUTE 4 = (value) ATTRIBUTE 5 = (value)	
..	
ITRUCK 18	Now access to all elements of ITRUCK 18 is requested.
..	
C 4 5	Using the CHANGE or C command ITRUCK 18, attribute 4 is changed to a value of 5.
..	
IUNIT 20 25	All elements of IUNIT 20 thru IUNIT 25 are accessed.
..	
C 4 6	The requested IUNITs 20-25 have attribute 4 set to a value of 6.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
..	
IATP	The entire IATP array is requested.
C 5 0	Throughout IATP attribute 5 is zeroed.
..	
ITRUCK 1 10	Now the LEAP and SKIP commands will be addressed. LEAP allows the user to address selected variables from an array, i.e., every second variable, every third variable, etc. Here the first 10 variables in the ITRUCK array are accessed.
..	
LEAP 4	Every fourth variable between ITRUCK 1 and ITRUCK 10 is requested.
..	
L 1	The first attribute of those variables is to be listed.
ITRUCK 1	
ATTRIBUTE 1 = (value)	
ITRUCK 5	
ATTRIBUTE 1 = (value)	
ITRUCK 9	
ATTRIBUTE 1 = (value)	
..	
LPPAR 1	The array LPPAR is accessed.
..	
SKIP 3	Unlike the LEAP command, the SKIP will enable the user, in the same fashion, to select certain attributes of a variable. Here every third attribute is selected.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
L	
LPPAR 1	
ATTRIBUTE 1 = (value)	
LPPAR 1	
ATTRIBUTE 4 = (value)	
LPPAR 1	
ATTRIBUTE 7 = (value)	
..	
ITRUCK 1 5	Here the two commands will be used together.
..	
LEAP 4	
SKIP 4	
L 1 10	
ITRUCK 1	
ATTRIBUTE 1 = (value)	
ATTRIBUTE 5 = (value)	
ATTRIBUTE 9 = (value)	
ITRUCK 5	
ATTRIBUTE 1 = (value)	
ATTRIBUTE 5 = (value)	
ATTRIBUTE 9 = (value)	
END	No further commands in the EDIT DATA FILES Option are requested at this time.
???	As before, the menu may be displayed. This time the next option is asked for instead.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
2	The update FA current supply (100%) option is selected. Since the data base being edited already contains data, it may be desirable to simulate previous stockpiling of artillery ammunition. The procedure is accomplished automatically. For all FA IUNITs, words 10 and 11 are zeroed, and word 12 becomes the arithmetical product of words 9 and 15.
???	
6	Now the CLOSE ATP option is selected.
ENTER (CFA) ATP NUMBER "O BE CLOSED	The CFA ATP number may now be entered. In this case a value of '6' has been equated to the CFA ATP.
6	ATP 6 will be closed. Its S&P trucks pulled out, redistributed to other ATPs, and its ammunition left on the ground. ATP 6 should be selected as it is the CFA ATP.
END	ATP closings have been completed.
???	
4	The MODIFY TRK QUEUES option is selected. In developing the data base it is necessary to assign all trucks to their respective queues (units). In the ITRUCK array of the data base the trucks were assigned owner numbers coinciding with the IUNIT array numbers. In order for the model to find these trucks it is necessary to put the trucks in their respective queues. For example, all trucks assigned to owner 10 must be put into queue 10 and trucks assigned to an ATP which have on board the initial stockage of ammunition at the ATP must be put in the right queue for that ATP. The complete truck queue list appears in the data base description. Trucks that will be set in motion at the beginning of the game should not

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
	be placed in a queue. This is any truck assigned a status code 4. Commands available for this option are GET or G, TAKE or T, LIST or L and PUT or P. Some command examples follow.
...	System is awaiting command.
GET 3 35	Truck 3 is removed from queue 35.
...	
P 3 36	Truck 3 is placed in queue 36.
...	
LIST 105	A request for a list of queue 105 trucks.
49	A list of queue 105 trucks.
51	
52	
...	
P 4,10 36	Trucks 4 through 10 are placed in queue 36.
...	
T ENTER QUEUE NUMBER (999 TO TAKE OUT FROM ALL QUEUES)	The TAKE command. A queue number will zero a queue of all trucks. A 999 will zero all queues.
110	
...	
END	No further truck queue processing is desired.
???	
5	The PRINT TRUCK QUEUES option is called. A hardcopy listing of all queues with the truck numbers of the trucks they contain is now assembled for printout after the terminal session concludes.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
???	
3	The STOP option is picked, signifying that editing is currently complete.
SSG ARMPL.DP WILL SYM THIS REPORT	This is a reminder to the operator that commands are to be issued now to transmit and print the new ARM data base and the Truck Queue Report from a remote site to the DPFO computer (if desired).
@SSG ARMPL.DP	This initiates the action.
SSG 20R1S74T27 03/08/83 08:50:42	The SSG is invoked at this date and time.
SGS	Provides input for the SSG.
DP CI01	This inserts a necessary control card for the SSG.
@	Signifies that all SSG information has been provided.
END SSG. ERRORS: /0/0/0 TIME: 3.572 STORAGE: 6336/0/6368/053777 LINES: 7/7 RETAIN LEVEL 1.2 READY READY READY READY READY READY	Indicates successful SSG processing.
@XQT ARMPL.DATA	Begins execution of the program that will print the ARM data base.
ENTER CI NUMBER	A prompt to enter the new CI number.
01	The two digit new CI number.
ENTER ARM DATA BASE OPTIONS	Here a menu has been suppressed. A "1" option will print out the complete data base. It is always most advantageous to select this option to have all the information together and the printout is small enough not to be unwieldy. An example of this printout appears in Volume III.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
1	
@FREE 2 @SYM DPCI--(or SYM,U DPCI--TO SAVE FILE)	System reminders to obtain printouts, if desired. The Sym, U option is necessary to save a human readable file.
@FREE 2	File 2 is released from the run.
READY	
@SYM,U DPCI01	Schedules printing copies of the print file and directs them to the DEMO computer.
@FIN	Terminal session is now complete. The new data base resides on file DATABCI01.. Some accounting information now prints to the screen.

e. Building the Events File. In the running of an initial ARM CI an affirmative reply is given to the prompt "DO YOU WISH TO ADD EVENTS?". This reply will result in the reading in of an initial events tape created through the use of programs ADDEVT and CONVRT. ADDEVT allows the user to create a source tape file on a File 12 called TEVENTSCI__, where the underscores stand for the two digit CI number. CONVRT then converts the file to binary for use in the ARM program. Instructions for the use of these programs follows. An events tape may be read in prior to any CI, but it is necessary before running the initial one. ARM is set up to require an initial "push" of S&Ps from the CSA to replenish stockage objectives at the ATPs and ASPs. Once this is done initially the process will continue on its own.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@SSG ARMPL.ADDEVTSARM	Program is made into machine readable card images. SSG is invoked.
SSG 20R1S74T27 02/27/83 08:25:29	
SGS	Input being provided to SSG.
ADD CI(N)	'N' is the CI for which events are to be entered expressed by two digits with leading zeroes if necessary.
@XQT ARMPL.ADDEVTS	Program is executed.
END SSG.ERRORS: 0/0/0 TIME: 3.572 STORAGE: 6336/0/6368/053777 LINES 9/9 RETAIN LEVEL 1.2 READY READY READY READY READY READY READY	Message and series of "READY"s is displayed, then user prompts begin, SSG processed successfully.
ENTER EVENT TYPE, PARMS, TIME, SEPARATED BY COMMAS ENTER 0,0,0,0,0 TO COMPLETE ADDITION OF EVENTS ???	User prompt to begin entering events. Event types and their parameters are listed in the Data Base Description of this chapter. The TIME is the event time.
5,1,500,2,0,5,50.	A truck arrival at ASP 2 for truck 500, 50 minutes into the simulation run has been scheduled. The zero is a required entry even though that parameter is not applicable to a type 5 event. If an incorrect event type is entered the message: "INCORRECT EVENT TYPE" "?" is displayed and another event may be entered.
?	Prompt for entry of another event.
0,0,0,0,0	All events have been entered.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
DO YOU WISH TO SEE EVENTS--- Y OR N	An affirmative reply will list all events in the order entered in seven columns.
N	
PUT EVENTS ON FILE 12---Y OR N	A negative answer will stop the program with no events having been entered.
Y	
EVENTS NOW ON FILE 12	
@FIN	Terminal session ended.

CONVRT USER INSTRUCTIONS

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@SSG ARMPL.CONEVENTS	SSG is invoked to put program into correct format.
SSG 20R1S74T27 02/28/83 08:55:30	SSG begins.
SGS	Inputs to be provided SSG.
CON CI(N)	'N' is the CI to be done now. Express as two digits inserting leading zeroes if necessary.
@XQT ARMPL.CONVRT	Program execution begins.
END SSG.ERRORS: 0/0/0 TIME: 3.572 STORAGE: 6336/0/6368/053777 LINES 9/9 RETAIN LEVEL 1.2 READY READY READY READY READY READY READY	SSG processing successfully completed.
FILE 11 IS NOW COMPLETE	Events tape is successfully processed.
@FIN	Terminal session completed.

f. Building Distance Files. In every CI [illegible] distance file is read into the IUNIT array. It describes the distances between the center of mass of the batteries or maneuver units and their servicing ASP/ATP. It is built initially in program UNITDIST. After the initial CI it is modified using program MODDIST. The two programs are very much alike their basic difference being that UNITDIST creates a file and MODDIST modifies the contents of that existing file. Instructions for running these programs follow. [illegible] information is placed on a File 13.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@ASG,UP DISTFILECI(N+1)	A distance file is made available for this run. 'N' is the two digit CI number (leading zeroes if necessary) to which these distances will apply.
READY	
@USE 13, DISTFILECI(N+1)	Program is directed to write to a file 13.
READY	
@XQT ARMPL.UNITDIST	Program is executed.
ENTER UNIT NUMBER (99 TO END)	User prompt to enter unit numbers to build a file containing ATP and ASP distances from the center of mass of the batteries or maneuver units.
1	Unit number = 1. If an inapplicable number is entered the message "INCORRECT ENTRY" is displayed and the program returns to the previous prompt.
ENTER ATP, ASP, ATP DISTANCE, ASP DISTANCE SEPARATE ENTRIES BY COMMAS	Any entry that has an out of bounds value will send the program back to the previous prompt after displaying "INCORRECT ENTRY".
1,1,65,10	A sample entry is made. ATP1 and ASP1 are assigned distances of 65 and 10 respectively.
ENTER UNIT NUMBER (99 TO END)	The original prompt is repeated.
99	The sample entries are complete.
DO YOU WISH TO SEE VALUES (Y OR N)?	If answered affirmatively the values for all units are displayed, as they were entered, with the unit number followed by the four columns of entries.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
N	
PUT ON TAPE (Y OR N)	If "Y" the entries are written to a tape and the program ends.
N	
ENTER UNIT NUMBER TO CORRECT	
1	A correction to the ASP distance will be shown here for Unit 1.
UNIT NO. ATP ASP ATP DIST ASP DIST 1 1 1 65 10	System display of current values.
ENTER UNIT NUMBER (CHANGE IF NECESSARY)	
1	
ENTER NEW ATP, ASP, ATP DIST, ASP DIST.	
1,1,90,10	Correcting the ATP distance to 90 km.
ANY MORE UNITS TO CORRECT (Y OR N)	If "Y" program returns to "ENTER UNIT NUMBER TO CORRECT".
N	
PUT ON TAPE?	If "N" the message "WISH TO EXIT PROGRAM" is displayed. This prompt should be answered affirmatively, causing the program to stop, and necessitating a later rerun.
Y	
TAPE 13 IS COMPLETE	
STOP 1232	System message of successful termination.
@FIN	Terminal session is completed.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@SSG ARMPL.RUNDIST SSG 20R1S74T27 02/27/83 08:30:31	Program put into machine readable form. SSG is invoked.
SGS	Input being provided to SSG.
DIST CI(N),CI(N+1)	Distance files for former and current CIs are provided. 'N' again in two digits with leading zeroes if necessary.
@XQT ARMPL.MODDIST	Program execution begins.
END SSG.ERRORS: 0/0/0 TIME: 3.572 STORAGE: 6336/0/6368/053777 LINES 6/6 RETAIN LEVEL 1.2 READY READY READY READY READY READY	SSG has processed successfully.
WISH TO EDIT ALL OR SOME (A OR S)?	If "A", entries are displayed and the user is asked whether or not he wants to put them on tape. If "y" program is exited. If "N" program is routed the same as if "S" had been chosen in the first place.
S	Instructions are substantially the same as for UNITDIST hereafter. If the 'S' option is chosen a display of values for all units is shown, though not in this example, for brevity. Format is five columns headed: UNIT NO. ATP ASP ATP DIST ASP DIST

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
ENTER UNIT NUMBER (99 TO END)	User prompt to enter unit numbers to build a file containing ATP and ASP distances.
1	Unit number = 1. If an inapplicable number is entered the message "INCORRECT ENTRY" is displayed and the program returns to the previous prompt
ENTER ATP, ASP, ATP DISTANCE, ASP DISTANCE SEPARATE ENTRIES BY COMMAS	Any entry that has an out of bounds value will send the program back to the previous prompt after displaying "INCORRECT ENTRY".
1,1,18,25	A sample entry is made.
ENTER UNIT NUMBER (99 TO END)	The original prompt is repeated.
99	The sample entries are complete.
DO YOU WISH TO SEE VALUES (Y OR N)?	If answered affirmatively the values for all units are displayed, as they were entered, with the unit number followed by the four columns of entries.
N	
PUT ON TAPE (Y OR N)	If "Y" the entries are written on tape and the program ends.
N	
ENTER UNIT NUMBER TO CORRECT	
1	A correction to the ASP distance will be shown here for Unit 1.
ENTER NEW AT ATP, ASP, ATP DIST., ASP DIST.	
1,1,18,30	Correcting the ASP distance to 30 km.
ANY MORE UNITS TO CORRECT (Y OR N)?	If "Y" program returns to "ENTER UNIT NUMBER TO CORRECT".
N	

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
PUT ON TAPE?	If "N" the message "WISH TO EXIT PROGRAM" is displayed. This should be answered affirmatively, causing the program to stop, and necessitating a later rerun.
Y	
TAPE 13 IS COMPLETE	
@FIN	Terminal session is complete.

6. USER INSTRUCTIONS.

a. Overview. Following the initial CI the running of ARM becomes an iterative process. This consists of reading in the current data base, applying any necessary changes to it; reading in the demand from the attrition model; simulating the CI; and generating output in the form of printed reports and a newly modified data base. Having accomplished these steps, the next CI is run by incrementing the CI number and repeating the process.

b. Running a CI. Following are the steps to be taken to run ARM CIs. Much of what is presented has already been explained in the previous chapter under Building and Editing Data Files. Where a duplication does occur it is noted, a brief description given, and the user referred to the earlier chapter for more information. The format and assumptions remain the same as in the preceding material. For more details of the ARM programs and subroutines the user is directed to Volume II, the Programmer's Manual.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@SSG ARMPL,RUN	Puts ARMPL.RUN into machine readable format.
SSG 20R1 S74T27 03/09/83 08:37:24	SSG is involved at this time.
SGS	Provides information to the SSG.
FILES CI(N), CI(N+1), LOG(N)	List of files to be used. N is the current CI and N+1 the next CI. The CI files contain the ARM data bases. The Log file has the demand information from the attrition model. Both are expressed by two digit numbers (i.e., include lead zeroes, when applicable).
@	Signals SGS that all information has been provided.
END SSG.ERRORS:/0/0/0 TIME:3.584 STORAGE: 6336/0/6368/ RETAIN LEVEL 1.2 READY READY READY READY READY READY READY READY READY READY READY READY READY READY READY READY	The SGS has been completed successfully.
FACILITY REJECTED 4001000000 READY READY READY	This statement normally appears for all CIs after CI01. It is due to the fact that there is no file for additional events created by gamer. If you want to create additional events see program ADDEVT, described in Chapter 5.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@XQT ARMPL.ARM	The main ARM program is executed.
QNIT	Message indicating an initialization routine for this CI is called
ARE YOU CREATING AN ANSWER FILE (Y OR N)	Statement is no longer applicable. Function is now performed in program EDITYES. A negative reply should be given.
N	
DO YOU WISH TO ADD EVENTS?	Answer in the affirmative for the first CI and negative thereafter. In the first CI, an extra file, created in program ADDEVT is read in. This program is explained in Chapter 5 and will allow the user to build a file of initial events.
Y	
ENTER TIME TO STOP SIMULATION	
2160.1	The time the run is to stop in this example. This is normally 240 or 360 minutes from the current CI start time.
[INITIALIZE TRUCKS TIMES SINCE LAST FAILURE]	The brackets here are to indicate that this message appears only on the initial CI. It is always answered positively.
TIME=1920.1	The current simulation time is now displayed.
?	This is to alert the user that he may now choose to display the ARM menu. On input of any number greater than or equal to eight the menu is displayed. Any number from one to seven allows the user to address the desired option directly.
9	The user requests the menu.
(1) EDIT DATA (2) WRITE REPORT (3) SCHEDULE CONTROL	The ARM menu and current simulation time appear.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
(4) RETURN (5) STOP SIMULATION NOW (6) EDIT TRUCK QUEUES (7) CREATE EVENTS TIME=1920.1	
1	EDIT DATA option is chosen. This allows the user to perform editing functions described in the previous chapter under the EDIT DATA FILES option of the EDIT program. It should be noted; however, that changes made in this way do not permanently change the data base in case a rerun becomes necessary. Only a brief example will be given here.
VARIABLE NAME=	Request for the name of the variable to be accessed.
INTER ..	INTER is selected. This relates to truck kills.
C 3 10 ..	Word 3 is set equal to 10.
END	Editing is done for now.
TIME = 1920.1	Current simulation time.
?	Request for menu option.
2	WRITE REPORT option is chosen.
ENTER NUMBER OF ACTIVE ATPS (1,2,..., or 10)	
6	
ENTER NUMBER OF ACTIVE ASPS (1,2,..., or 10)	
4	For this example there are 6 active ATPs and 4 active ASPs. Several reports result from this option. They are the truck report, unit report, ATP report, ASP report, and a trucks killed or broken down report. Their contents are explained in chapter 7 of this volume.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
TIME = 1920.1	Current simulation time.
?	Option or menu choice is repeated.
3	The SCHEDULE CONTROL option is selected. This is often done for reasons such as: the user wishes to look at certain data values, change some values or print some reports just prior to ending the CI.
ENTER TIME FOR NEXT CONTROL	The user is prompted to enter the time for ARM to return to the control routine.
2160.05	At 2160.05 ARM will return to control routine and the menu will be displayed if desired. This will allow report printing just before the CI ends.
TIME=1920.1	Current time displayed.
?	Option or menu may be selected.
6	The EDIT TRUCK QUEUES option is picked. The user may now proceed to perform the functions described in the previous chapter under the MODIFY TRUCK QUEUES option of the EDIT program.
END	This option is left. Examples were given earlier in Chapter 5.
TIME = 1920.1	Current simulation time.
?	Options or menu choice.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
7	CREATE EVENTS is called.
TO CREATE AN EVENT, INPUT AS A GROUP SEPARATED BY COMMAS OR SPACES SEVEN VALUES: EVENT TYPE (INTEGER VALUES BETWEEN 1 AND 17 5 PARAMETERS FOR EACH EVENT (INTEGER, DEPENDING ON EVENT TYPE), AND TIME (DECIMAL, MINUTES REAL). EXAMPLE 10, 1, 512, 0, 0, 0, 2100 - CSA-ATP TRUCK 512 WILL ARRIVE AT ATP AT TIME = 2100 MIN.	Instructional system message.
10,1,512,0,0,0,2100.	
?	Looking for entry of additional events.
END	No further events are to be scheduled.
TIME = 1920.1	Current simulation time.
?	Option or menu choice.
[5]	The STOP SIMULATION NOW choice. This will schedule a stop simulation event for the current time. In normal processing this would not be chosen, only when a restart is necessary. Therefore it appears in brackets.
4	Normally after exercising one or more of the options alternative 4 is chosen to start the processing of ARM.
HAVE FINISHED RDJIFF (other info) Scheduled stop, time =2160.05 SSG armpl. free; then SSG armpl. edityes TIME=2160.05	Information that the input tape from the attrition model has been processed. The other information, not actually shown here, consists of things like when unit ammunition becomes negative and how much or S & Ps busy at an ATP for a specific ammo and when, etc. The other information is displayed to remind user of steps to take to get printout.
?	ARM menu option.
2	The WRITE REPORT option is chosen directly.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
ENTER NUMBER OF ACTIVE ATPS (1,2,...or 10)	
6	
ENTER NUMBER OF ACTIVE ASPS (1,2,...or 10)	
4	
TIME = 2160.05	Current simulation time
?	Menu option.
4	The RETURN option.
TIME=2160.1	This is the end of simulation time.
SSG ARMPL.FREE; THEN SSG ARMPL.EDITYES	To remind the user. This now to initiate process of editing data for the following CI.
@SSG ARMPL.FREE	Putting ARMPL.FREE into machine readable form.
SSG 20R1 S74T27 03/08/83	Previous statement successful.
SGS	To send information to the SSC.
EDIT CI(N), CI(N+1)	CI(N) to be edited and renamed CI(N+1)
@XQT ARMPL.EDIT	Executing the EDIT program
ZERO COUNTERS?(YES OR NO)	
Y	
MODIFY INTER,IDAY,TCILNG, ASP STATUS	
???	EDIT menu option. All that is being shown now was explained in the previous chapter under Building and Editing Data Files. Only a brief example will be shown here.
1	EDIT DATA FILES option.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
VARIABLE NAME=	
INTER	
..	
C 3 3	
...	
C 4 3	
..	
C 7 60	Some truck interdiction parameters are set.
...	
IDAY	
..	
C 1 0	A night CI is chosen.
..	
TCILNG	
..	
C 1 360	A 360 minute CI length is selected.
..	
END	Editing option 1 ends.
???	
5	The print truck queue option.
???	
6	The STOP option. Editing is complete.
SSG ARMPL.DP WILL SYM THIS REPORT	User reminder.
@SSG ARMPL.DP	Preparing machine readable input.
SGS	Providing SSG information.
DP CI(N)	Inserts a control card into SGS stream.
@	Signifies that all SSG information has been sent.
END SSG.ERRORS:/0/0/0 TIME:3.572 STORAGE:6336/0/6368/ 053777 LINES:5/5 RETAIN LEVEL 1.2 READY READY READY READY READY	SSG is successful.

USER RESPONSES AND SYSTEM MESSAGES	REMARKS
@XQT ARMPL.DATA	ARMPL.DATA is executed.
ENTER CI NUMBER	
(N)	Carrier equipment number is entered.
ENTER ARM DATA BASE OPTIONS	Here a menu is suppressed. Typing '1' will print out all available information.
1	
@FREE 2	User reminder.
@SYM DPCI--(OR @ SYM,U DPCI--TO SAVE FILE)	User reminder.
@FREE 2	
READY	
@SYM DPCI(N)	Reports are sent to main printer. This completes the run. (N) may now be incremented and the process repeated for the next CI.

7. TYPES OF OUTPUT. At the completion of a specified period of simulated combat, ARM is designed to provide a complete status report on the ammunition resupply network of the division. These reports scheduled by the gamer can be written at any time during the CI, but generally are scheduled near its completion (see user instructions for explanation of scheduling reports). The report lists the following categories:

1. Unit Data
2. ATP Status
3. ASP Status
4. Unit Truck Resupply In ormation

a. Unit Data. The unit report provides the current status of each unit, reflecting unit identification and type, servicing ATP and ASP and the respective distances. Additionally, it identifies each ammunition type used by the unit. For each type it specifies the associated weapon, the number of surviving weapons, the current supply of ammunition on the weapons, number of rounds on the way to the unit, the percent of basic load on the weapons and the number of rounds on unit trucks located at the unit. Also specified for each ammunition is the total demand for the past period of combat. Included is the status of all trucks assigned to the unit. Each truck lists the truck number, its mission, status, mix number for the type of ammunition it is carrying, the percentage of its ammunition load which is currently left on the truck, and how many minutes are left before it breaks down. Figure 7-1 lists an example of unit data.

b. ATP Status. For each active ATP, this portion of the report lists the number of unit trucks waiting to be serviced, and the status of ammunition supplies. For each type of ammunition stocked at that ATP, the report lists the current supply on hand, the current demand for trucks waiting to be serviced, and replenishment rounds which are on the way to the ATP. Figure 7-2 shows an example of a ATP Status and ATP Queue Information. At the end of the status of the last active ATP the report prints out ATP Queue Information. This section shows for each active ATP, the number of unit trucks serviced, the average wait time and the maximum wait time for unit trucks in two categories - maneuver units and artillery units.

c. ASP Status. For each active ASP for each ammunition type stocked this section of the report details the following: number of trucks waiting for resupply, number of rounds currently in stock, demand of trucks waiting to be serviced (in rounds) and number of rounds due in to the ASP. Figure 7-3 lists an example of this section.

d. Unit Truck Resupply Information. For each type of unit (see paragraph 4 for unit types) the following is recorded: trips to an ATP and average trip time, trip to an ASP and average trip time, percentage of trips which went to an ASP, time spent in reloading weapon systems, total time all trucks for that type were available, total time when all trucks were idle, and the percentage of time trucks were idle. Also printed are truck movement data for each unit type showing for each type of move: number of trucks sent, number interdicted, number which needed maintenance and the average travel time for the type of movement types. See paragraph 4 for a description of movement types. Figure 7-4 is an example of unit truck resupply information.

UNIT STATUS

UNIT DATA

WPN DATA

	AMMO-CODE	WPN-TYP	WPN-ALIVE	CUR-SHT	RODS-AWAY	PCRI-W	ON-TARG	NO WPN SU / NO SU FA	TOT-AMMO
TEIA	1 1								
[illegible] ATD 3 32 KM									
SFD ASP 12 55 KM									
NO HELO **									
	1	TANK	27	1128	5	75	720	2 / 2	224
	2	TOW	1	10	2	87	61	1 / 2	2
	3	TOW	10	56	2	97	61	3 / 3	4
	16	MORTAR	6	630	0	100	100	0 / 1	331
	17	BUSHMAST	19	5052	0	101	818	0 / 0	1036

TRUCK STATUS REPORT FOR UNIT TEIA

TRK	VH	STATUS	MIX	PCLOAD	%FAIL
1	1	A	1	[illegible]	17[illegible]
2	1	C	1	[illegible]	[illegible]
3	1	1	1	[illegible]	[illegible]
4	1	1	1	[illegible]	[illegible]
5	1	1	1	[illegible]	[illegible]
6	1	[illegible]	16	[illegible]	[illegible]
7	1	[illegible]	16	[illegible]	[illegible]
8	1	1	32	[illegible]	[illegible]
9	1	1	32	[illegible]	[illegible]
10	1	1	32	[illegible]	[illegible]

Figure 7-1 UNIT Page

ATP STATUS

ATP NO 1

QUEUE	ARTY	MU
TRUCKS IN Q	1	5

AMMO-CODE	AMT-OAH	CUR-DMD	ON-THE-WAY
1	1921	0	0
2	576	0	0
3	1928	0	1
4	1[illegible]	0	0
5	48	0	0
6	1	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	19720	0	0

ATP STATUS

ATP NO 2

QUEUE	ARTY	MU
TRUCKS IN Q	1	1

AMMO-CODE	AMT-OAH	CUR-DMD	ON-THE-WAY
1	2160	0	0
2	396	0	198
3	864	136	0
4	127	0	1
5	336	136	0
6	1	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	13744	0	0

ATP QUEUE INFORMATION

ATP NUM	TRKS SERVED MANOVER QUEUE	AVG TIME IN QUEUE	MAX TIME IN QUEUE	TRKS SERVED ARTY QUEUE	AVG TIME IN QUEUE	MAX TIME IN QUEUE
1	0	0	0	27	1	27
2	2	1	2	31	3	36
3	6	2	6	27	6	29
4	7	5	26	32	11	38
5	1	1	1	46	11	16
6	5	3	6	20	1	13

figure 7-2 atp data

ASP STATUS

ASP-NO 10

QUEUE	ROUTINE	MESS
TRUCKS IN Q	6	3

INVENTORY	AMMO-CODE	AMT-O/H	DEMAND	ON-THE-WAY
	1	960		0
	2	192	64	160
	3	7650	0	0
	4	1248	1	0
	5	4352	272	0
	6	288	0	216
	7	1728	72	0
	8	3024	1	0
	9	48	72	216
	10	972	1	0
	11	648	0	0
	12	2430	0	540
	13	6480	0	4320
	14	0	2500	43040
	15	1458	0	972
	16	15336	0	0
	17	2250	0	0
	18	26460	0	17640
	19	0	0	0
	20	11020	0	0

ASP STATUS

Figure 7-1. ASP Status

UNIT TRUCK RESUPPLY INFORMATION (EIGHT THREE TIMES IN HOURS)

UNIT TYPE	TRIPS TO AN ATP	AVG TRIP TIME	TRIPS TO AN ASP	AVG TRIP TIME	PERCENT TO ASPS	TIME FOR WPN RELOAD	TOTAL TIME AVAILABLE	SLACK TIME	PERCENT SLACK
1	6	99	2	230	25	81	936	831	88
2	1	0	0	0	0	14	792	777	98
3	5	134	4	238	56	63	354	255	72
4	144	116	167	326	54	440	4226	2805	66
5	52	135	57	317	53	235	2794	2105	75
6	26	136	50	176	66	110	0	-500	0
7	0	0	4	352	100	19	138	92	66
8	7	154	14	311	66	36	312	179	57

TRUCK MOVEMENT DATA FOR UNIT TYPE 1

TYPE MOVE	TRUCKS SENT	TRUCKS KILLED	TRUCKS FAILED	AVG TRAVEL TIME
1	6	1	5	34
4	2	2	0	128
5	0	0	0	0
4	0	0	0	65
5	2	0	0	162

figure 7-4 resupply data

8. DATA SENSITIVITY. Much of the data used in ARM is Scenario [illegible] dependent. As such this data varies greatly, depending on the situation being simulated and is subject to user control. Some data however is designed for usage in most ARM runs. Described below is some of this data.

a. Weapon load times. The time required to set up and load weapons is based on data obtained from appropriate schools and centers. A data sensitivity run was made adding ten percent to each of these times and running the model for twenty-four hours of simulated combat (5 CIS). No significant change across the force was noted in total current supply on weapons for the units.

b. Truck travel times. The speeds at which trucks travel (primary and secondary road speeds) were average values obtained from the Transportation School. In making a sensitivity run, ten per cent was added to these times and across the force no significant change in total current supply on the weapons was noted.

c. Reload times for unit trucks. The times spent in resupplying unit trucks at ATPs and at ASPs are based on data obtained from the Missile and Munition Center and School (MMCS). When ten percent was added to these times no significant change in total current supply on weapons across the force could be noted.

d. General comments. Some data values maintained in the data base such as ammunition codes, unit types, truck types, and status and mission of units are somewhat arbitrary (see chapter 5 for current values). CARE SHOULD BE TAKEN IN ALTERING THESE VALUES. Parts of the logic flow of ARM use these values in critical decision-making processes; therefore changes to the code would be necessary if they should be altered. It is suggested that the user contact CAORA, Ft. Leavenworth before changes are implemented.

1. Background. It is a known fact that ammunition consumption fluctuates with each unit based upon type and intensity of combat. Most combat models that simulate division or corps wargames do not generate ammunition consumption data that is believable and acceptable to all parties. FM 101-10-1 is out of date and not useful for out-year planning where new weapons systems are being played against a target rich threat. The CAA rates, although developed for the out years, are unrealistically low and of little value in combat development work, particularly ammunition requirements analysis. Resupply analysis cannot be conducted based on 180 day averages. The combat arms schools, on the other hand, generate more realistic consumption rates from their high resolution models. Rates that are to be developed which reflect the variability of unit consumption and fluctuate as the more realistic expenditure rates of higher resolution models.

2. Basic Ammunition Consumption Rates. The [illegible] schools were asked to develop windows - i.e. most likely [illegible] of rounds per day expenditure rate for their respective major weapon systems under a variety of combat conditions. These conditions were [illegible] of the following:

Combat Posture: Delay, Intense Defense, Mid Defense, and Attack
MOPP Levels: 1 (Actual MOPP level 1 & 2)
2 (Actual MOPP level 3 & 4)

Since the scenario used in ARM runs listed some units in a mid delay, mid defense, and light delay intensity, values for mid intense consumption were developed by taking 65 percent of the mid-point of the Delay and Intense Defense windows and establishing a range comparable to the ranges of other windows. A light delay window was developed by using 30% of the mid point of the delay windows and establishing a comparable range. Since the scenario used did not list visibility conditions, these parameters were not used.

3. MOPP Degradation. MOPP 4 values were computed as follows: 0.7 for 1st day in MOPP 4, 0.5 for second day, 0.4 for any successive days. These values were applied to the mopp level 1 rates whenever a unit was in a MOPP 4 condition.

4. Distribution of Demand. In addition to the daily rates per weapon system and MOPP degradation factors, it was necessary to distribute the daily rate over the daylight and nighttime portion of the 24 hours of combat. It is assumed that 60% of all ammunition is fired during daylight hours; 40% at night. For artillery units firing different types of ammunition (i.e. HE, ICM, RAP, COPPERHEAD, etc.) the daily rate is further distributed amongst the different types under consideration according to the formula given from the US Army Field Artillery School. Figure A-1 shows the ammunition consumption windows (MOPP Levels 1 and 2). A detailed methodology of how the demand generation program used in conjunction with ARM works is available in chapter 4 of this volume.

	TANK	CFV	IFV	BUSHMASTER	MORTAR	155	81N	MLRS	DIVAD	HELLFIRE	30MM
DELAY CF	87-30	20-8	12-5	300-100	350-190	550-450	380-300	210-150	630-450	4 Mission 64-58	2500-1500
MID DELAY (MBA)	56-15	15-3	8-2	480-300	232- 92						
LT DELAY (MBA)	30- 5	5-1	4-1	200- 60	84- 24						
INTENSE DEFENSE	93-35	20-8	12-5	750-550	420-240	550-450	380-300	210- 75	720-540	3 Mission 48-40	2000-1000
MID DEFENSE	60-24	12-5	8-2	480-300	295-135	375-275	261-181	145- 85	458-298	2 Mission 32-24	1000- 850
LT DEFENSE	35-10	8-4	10-2	200- 60	135- 80	250-150	186- 86	100- 50	300-180	1 Mission 16-12	500- 400
ATTACK	70-25	12-7	11-4	700-500	275-140	550-450	380-300	210- 75	480-300	2 Mission 32-26	1500-1000

Figure A-1 Ammunition Consumption Windows (MOPP Levels 1 and 2)

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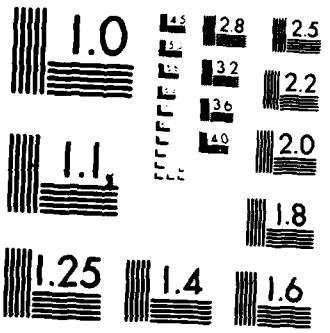

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